CLINICAL PRACTICE GUIDELINE

The Pathogenesis, Assessment and Treatment of Speech Fluency Disorders

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SUMMARY

Background: Approximately 1% of children and adolescents, 0.2% of women, and 0.8% of men suffer from stuttering, and lesser numbers from cluttering. Persistent speech fluency disorders often cause lifelong problems in communication and social participation.

Methods: In an interdisciplinary, evidence and consensus based clinical practice guideline, the current understanding of the nature, identification, diagnosis, and treatment of stuttering and cluttering was summarized. A systematic review of the literature was carried out to assess the efficacy and effectiveness of treatments for stuttering. Evidence is lacking on the etiology, pathogenesis, evaluation, and treatment of cluttering.

Results: In view of the fact that common (developmental, idiopathic) stuttering is associated with structural and functional changes of the brain, the guideline recommends that it should be called "originary neurogenic non-syndromic stuttering." Heritability estimates for this disorder range from 70% to over 80%. For preschool children, the Lidcombe therapy has the best evidence of efficacy (Cohen's d = 0.72–1.00). There is also strong evidence for an indirect treatment approach. For children aged 6 to 12, there is no solid evidence for the efficacy of any treatment. For adolescents and adults, there is good evidence with high effect sizes (Cohen's d = 0.75–1.63) for speech restructuring methods such as fluency shaping; weak evidence with intermediate effect sizes for stuttering modification (Cohen's d = 0.56–0.65); and weak evidence for combined speech restructuring and stuttering modification. The evidence does not support the efficacy of pharmacotherapy, rhythmic speaking, or breathing regulation as the sole or main form of treatment, or that of hypnosis or eclectic, unspecified stuttering therapies.

Conclusion: Stuttering is often treated in Germany with therapies for which there is inadequate evidence, and the initiation of treatment is often unnecessarily delayed. The guideline presents treatment methods whose efficacy is supported by the current evidence.

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Worldwide, about 1% of children and adolescents as well as 0.2% of women and 0.8 of men suffer from stuttering (ICD-10: F98.5) (1, 2). Reported prevalence rates for cluttering (ICD-10: F98.6) are lower, but no precise numbers are known. For a considerable part of these speech fluency disorders, treatment is needed. To identify, diagnose, and treat speech fluency disorders, 17 expert societies in Germany have developed a clinical practice guideline based on consensus and evidence, and have published this on the website of the Association of Scientific Medical Societies in Germany (AWMF) as well as in book format (3, 4) (*eTable 1*). As the evidence relating to cluttering is less strong than that for stuttering, this article focuses primarily on stuttering.

Methods

The guideline is based on a comprehensive literature search. The text was composed and agreed by the 8-member guideline author group and went through a two-stage formal voting procedure among the consensus group—initially, persons with conflicts of interests were excluded, and the vote was then repeated with these persons included. The results did not show any notable discrepancies. For the central question of the efficacy and effectiveness of therapies for stuttering we conducted a systematic literature review (*eFigure 1*) after four researchers (KN, HAE, HGB, SC) had independently searched the databases Web of Science, PubMed, PubPsych, and Cochrane Library. The search included publications from 2000 to April 2016. 43 publications met the methodological criteria. Two reviewers independently checked the identified publications for stuttering-specific inclusion criteria (effectiveness of measures to reduce stuttering; $N \geq 12$; effect sizes reported or calculable; a minimum of two repeated measurements; follow-up period of at least 6 months).

The evaluation of the methodological quality of the included systematic reviews and meta-analyses was based on the recommendations of the Scottish Intercollegiate Guidelines Network (SIGN) (e1); that of the randomized controlled trials and non-randomized controlled trials, non-controlled prospective case studies, retrospective treatment studies, and narrative reviews was based on two checklists from the AWMF; and the allocation of evidence levels was based on the classification of the Oxford Centre for Evidence-based Medicine (e2). The recommendations of the guideline were agreed on in a nominal group process in two consensus conferences moderated by the AWMF.

Stuttering

Definitions

The guideline classifies speech fluency disorders into stuttering and cluttering and distinguishes between originary (neurogenic non-syndromal and neurogenic syndromal) and acquired (neurogenic and psychogenic) stuttering *(Figure 1)*. As the "common stuttering," hitherto known as "idiopathic," is accompanied by structural and functional cerebral anomalies, the recommendation is to substitute the term by "originary neurogenic non-syndromal stuttering" or, in what follows, simply "stuttering." The term describes a neurological impairment of speech and its planning, which develops in childhood owing to a genetic disposition. It comprises key symptoms with non-fluent speech that are typical for stuttering and also secondary symptoms with vegetative, motor, and emotional reactions to these dysfluencies. "Originary neurogenic syndromal" characterizes the kind of stuttering that can occur, for example, in trisomy 21 (Down syndrome). "Acquired neurogenic" stuttering can occur at any age after a brain injury (e3, e4). The very rare "psychogenic" stuttering develops usually after puberty acutely as a result of psychotrauma or an underlying psychiatric illness.

Course

Stuttering usually starts at the age of 2–6 years. The sex ratio in the early stage is 3 boys for every two girls. Subsequently, owing to sex-specific recovery, the ratio changes to 5 : 1 (up to five men to every woman) (e5–e7).

Persons who stutter recover spontaneously in 70–80% of cases, mostly before they reach puberty. The rate of spontaneous recovery is highest in the initial two years after onset of the disorder and falls rapidly afterwards (e8–e11). Risk factors for persistent stuttering include male sex, familial stuttering (especially persistent familial stuttering), onset of the dysfluencies more than 6–12 months ago, age at onset of stuttering >3–4 years, no reduction in stuttering severity within the initial 7–12 months (e12). An individual prognosis for recovery is not possible.

Symptoms

Table 1 describes the symptoms of stuttering and distinguishes those symptoms from normal speech dysfluencies. Since fluency problems typical for stuttering are not part of a child's normal speech development, the term "developmental stuttering" should no longer be used, and neither should the categorization into clonic and tonic stuttering.

Originary neurogenic non-syndromal stuttering is present if a minimum of 3% of all spoken syllables are stuttered. Independently of the frequency of stuttered syllables, stuttering should be assumed and diagnostically evaluated in case of single stuttering events of a long duration, emotional stress, avoidance behaviors, and other accompanying symptoms (strain displayed in the stuttering symptom, physical concomitants). In childhood and adolescence, the risk increases that the affected youngster will develop social phobias independently of the severity of his/her stuttering (e13).

Genetic origin

Twin studies (5–7, e14–e18) have confirmed that stuttering has a heritability of 69–85%. As a population-based concept, this finding of heritability does not allow any conclusions regarding individual cases, but it does allow the conclusion that stuttering in biological relatives predisposes to developing it. Furthermore, these studies confirm that the family environment shared by siblings is not a causative factor, or at best to a negligible extent. Twin siblings do not have a higher concordance of stuttering just because they grow up in the same family. This finding implies that contrary to assumptions so far, the family environment in early childhood—and thus parental interactions with children—do not—or hardly at all—contribute to the development of stuttering.

The molecular genetic search for types of genetic predisposition has thus far identified more than a dozen relevant loci (8, e19–e22). Stuttering is regarded as a multifactorial polygenic disorder, with many loci of different effects and interactions between genome and environment. Since thus far, only few gene loci have been confirmed, an urgent task for molecular genetic speech fluency research is the replication of findings (8).

Because a substantial proportion of the effects is of an additive nature, the currently favored model is a risk-threshold model. This means that the risk of stuttering increases with the number of loci involved, with a higher risk threshold in girls than in boys (9). It is to be expected, however, that more differentiated models will supersede the additive threshold model (8).

Cerebral findings

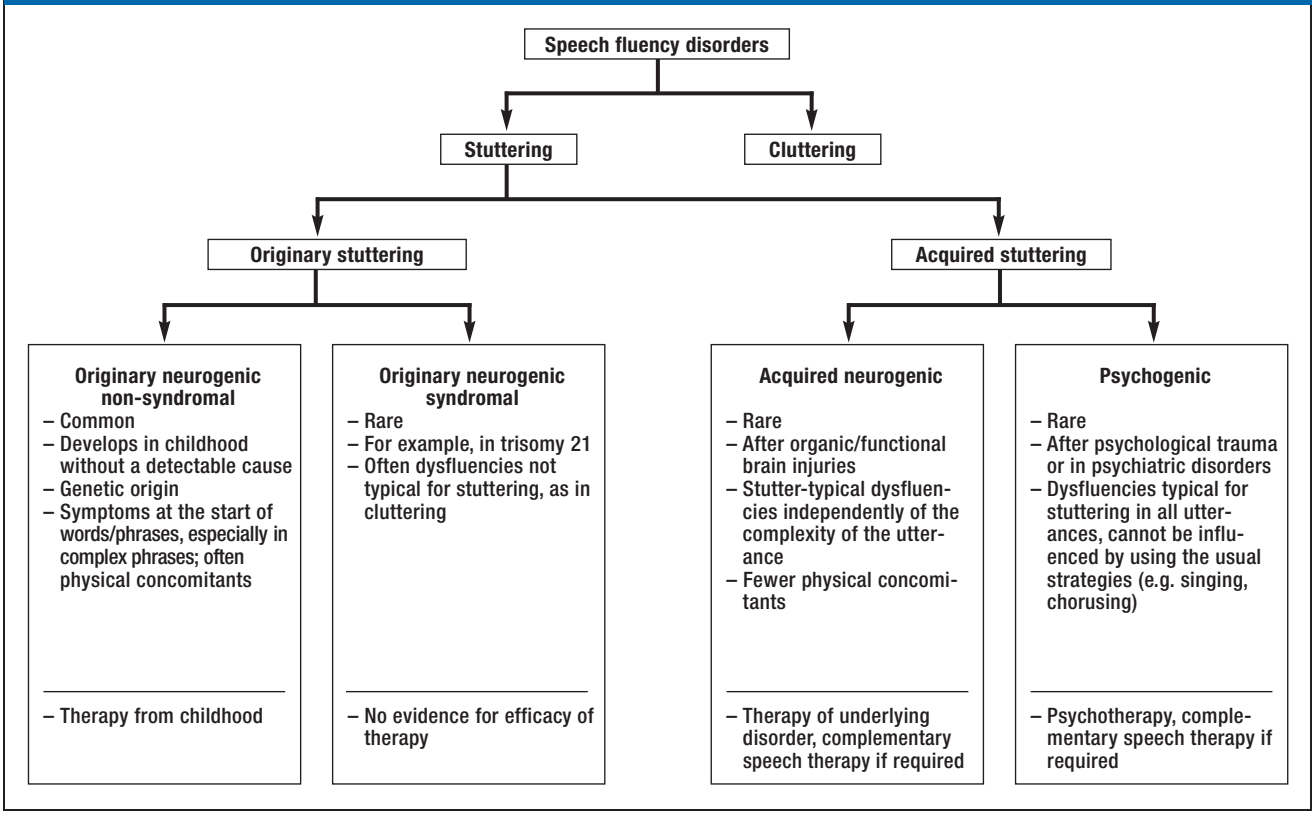
Stuttering is associated with morphological and functional abnormalities of the brain and is the expression of impaired interaction between auditory, somatosensory, speech planning, and speech motor neuronal networks, which is continually required in the generation of fluent speech (10–12, e23–e57).

Screening and diagnostic evaluation

One component of the regular German pediatric examinations at ages 3, 4, and 5 years is a question to parents whether their child stutters, in tandem with an assessment of the child's speech development. The Bochum–Aachen stuttering screening (BASS) instrument for physicians is recommended for more detailed or universal screening. This can be incorporated in pediatric screening or school entry examinations ([13], www.bvss.de/images/stories/projekte/BASS_2017.pdf). If there is a risk for or suspicion of stuttering, the Screening List for Stuttering (SLS) is available (14) (German-language version: [15]).

The diagnostic approaches listed in *Table 2* capture the symptoms of stuttering and the resultant socio-emotional burden. For objective assessment, different representative samples of at least 300 syllables of connected speech should be audio- or video-recorded. The

FIGURE 1



Classification of speech fluency disorders
(Adapted from [4]; with permission from Peter Lang AG International Academic Publishers)

recordings should be analyzed by frequency of stuttering (% of stuttered syllables), duration of the longest stuttering events, and physical concomitants and thus enable a classification by stuttering severity. Furthermore, one of two psychometric tests—the Stuttering Severity Instrument, fourth edition (SSI-4), or Test of Childhood Stuttering (TOCS)—should be administered. The Overall Assessment of the Speakers' Experience with Stuttering (OASES) or the German Speech Questionnaire (23) should be applied to document health-related quality of life. Furthermore, ratings of speech naturalness should be conducted by non-professional listeners. If required, ratings of the severity of stuttering should be undertaken by professionals who are not involved in the treatment. In any case, such ratings should not be the only measure if they come from treating therapists themselves. If an associated psychological disorder is suspected, patients should be referred for guideline-conform diagnostic evaluation. If covert stuttering is suspected, symptoms should be provoked by means of communication-based stressors, such as interruptions or requests to speak faster, and psychological stress should be documented by one of the questionnaires mentioned earlier.

The guideline includes an algorithm for the recommended procedure for identifying, diagnosing, and treating stuttering, and monitoring its course.

Therapy

In Germany, effective, well evaluated stuttering therapies exist alongside therapies of very little efficacy. Especially in childhood, extensive individual therapies without any identifiable therapeutic strategy are often undertaken (16). Systematic reviews and meta-analyses have identified effective therapeutic components. For adolescents and adults, these are methods that

- initially practice slowed-down speech intensively
- include group therapy
- practice the transfer into situations of everyday life
- include self-assessment/self-management in programmed steps
- strive for naturally sounding speech, and
- include maintenance programs, as well as
- practice prolonged speech, soft voice onsets, rhythmic speaking, breathing control, and attitudinal changes regarding speaking (17, 18).

As a rule, this is implemented by all approaches recommended in the guideline; in particular, the German Kassel Stuttering Therapy is supported by a solid amount of evidence (19–22).

Physicians and therapists should advise patients and their relatives about therapeutic principles that have been proved to be beneficial and thus enable them to make an informed decision on the type of therapy, its emphasis, and its objectives.

TABLE 1

Symptoms of stuttering and distinction from normal speech dysfluencies

Stuttering		Normal speech dysfluencies	
Symptom	Example	Symptom	Example
Repetition of sounds/syllables/ one-syllable words	"P-p-p-please!", "b-b-b-but"	Repetition of words/phrases	"Can't this---can't this be done in a better way?"
Pauses within words	"Rain...butt"	Word not completed	"No one has attem...."
Lengthening of sounds	"LLLLLeave me alone!"	Pause (filled with sound or silent)	"I have, erm, thrown it away", "I have --- thrown it away"
Blocks (audible or inaudible)	"I --- can't do this" (/c/ pronounced with strain)	Revision of words/utterances	"This is a nice --- not a nice program"
Accompanying symptoms in stuttering, psychological reactions to stuttering			
Symptom		Example	
Physical tension		Pressed voice, rising volume or pitch, tremor	
Change in speech respiration		Forced/irregular inspiration/expiration; audible exhalation before first syllable; stuttering on inspiration	
Physical concomitants		Facial expressions, gestures, movements of trunk or limbs	
Change in mode of speaking		Whispering, rhythmic or scanning speech, singsong, speaking on inspiration	
Speech avoidance behavior: preventive paraphrasing, rephrasing, substituting problematic or feared words		"I will take the c --- the vehicle"	
Insertion of sounds/syllables		"ar- um ar- um arrived"	
Insertion of words/set phrases		"And then – like – I – like – went home."	
Conspicuous change in communication		Change of subject; breaking off communication; verbal commenting, such as "That's not possible right now."	
Not completing sentences, repeating phrases, stop-and-go mechanisms (recoil)		"We did not [stop].....[go] even get there."	
Situational avoidance		Letting others speak on one's behalf; pretending to not be interested in the conversation; communication in writing rather than verbally	
Fear, embarrassment, shame		Fear of certain words or sounds, generalized speech anxiety, embarrassed laughing, turning away, covering mouth with hand, breaking off eye contact, fiddling around	
Vegetative reactions		Blushing, sweating, tachycardia	
Covert symptoms of stuttering			
Avoidance of situations		No verbal participation in school lessons	
Emotional reactions, psychosocial stress		Speech anxiety, shame, anger, frustration, helplessness associated with stuttering	
Cognitive reactions		Negative evaluation of one's own speech, low self confidence, pessimistic assessment of one's own social competence, excessive preparation for conversational situations	

(Adapted from [4]; with permission from Peter Lang AG International Academic Publishers)

According to the World Health Organization's International Classification of Functioning, Disability and Health (ICF) model, stuttering therapies should make speaking easier primarily by eliminating stuttering symptoms (core symptoms) or reduce these in quantity and/or improve speech quality and by enabling enabling to speak with mental and motor ease, without the need for constant self-monitoring. Therapies should reduce accompanying symptoms and psychoemotional stress, and have a positive effect on social participation, an active life, and quality of life. Psychoemotional stress may mean that treatment is required even in

TABLE 2

Diagnostic instruments for stuttering

Instrument	Age group	Topics	References
SSI-4*[1]	From age 2	Frequency of stuttering, mean duration of the 3 lengthiest events of stuttering, physical concomitants, speech naturalness, ordinal categorization into severity of stuttering	(e72)
TOCS*[2]	4–12	Extent of stuttering, behaviors related to stuttering, consequences of stuttering (ratings by investigator and/or reference person)	(e73)
Documenting stuttering in real time	All	Frequency of stuttering, speech tempo*[3], and speed of articulation*[4]	(e74)
OASES-S*[5] OASES-T*[6] OASES-A*[7]	7–12 13–17 ≥ 18	Everyday functioning, quality of life	(e75–e78)
Speech Questionnaire (psychosocial stress that stuttering causes in children and adolescents)	8–17	Indications of covert stuttering, quality of life	(23)
Repeated, scale-based assessment by therapist	All	E.g. accompanying motor behavior as in SSI-4, severity of stuttering	
Repeated, scale-based assessment by non-professional third parties	All	E.g. severity of stuttering, naturalness of speech	(e79)
Repeated, scale-based assessment by affected persons or parents	All	Everyday functioning, e.g. day- or situation-dependent stuttering severity, quality of life	

*[1] Stuttering Severity Instrument—Fourth edition
*[2] Test of Childhood Stuttering
*[3] Number of words/syllables including pauses, corrections, repetitions per time unit
*[4] Number of words/syllables spoken fluently per time unit, without fillers, pauses, corrections
*[5] Overall Assessment of the Speaker's Experience with Stuttering for schoolchildren, *[6] teenagers, and *[7]adults
(Adapted from [4]; with permission from Peter Lang AG International Academic Publishers)

covert stuttering because the severity of the stuttering does not correlate highly with such stress ([19, 23]; no correlation before therapy; temporarily low significant correlations post therapy, r = 0.20 and 0.44, respectively). Stress in school or at work can also be prevented by ensuring that disadvantages are compensated for (for example, equal opportunities in oral exams by allowing extra time or computer use, see www.bvss.de).

Treatment results should be monitored by follow-up examinations. After three months' therapy of at least one weekly session, notable improvements should be detectable in one of the therapeutic objectives; otherwise the therapeutic approach should be revised. Whether the therapy is intensive or extensive, delivered in an outpatient or inpatient setting, and provided as individual therapy or group therapy, the patient's possibilities should be considered. Intensive therapy using group components could be considered, as a retrospective survey of patients about the standard therapy types with sufficiently large case numbers showed greater effectiveness for such a setting (16). Subsequently and in *Table 3*, the efficacy of stuttering therapies available in Germany is listed according to the literature review that forms the basis of our guideline. These include:

- Approaches of speech restructuring (such as fluency shaping, Camperdown) are behavioral therapeutic methods in which a new pattern of speaking is learnt, which prevents, or is intended to prevent, dysfluencies typical of stuttering. Strong evidence supports such methods (16–22, e58–e61); they shall be considered when deciding on a therapeutic approach.
- Approaches of stuttering modification address occurring stuttering events directly by certain speech techniques while fluent parts of speech remain untouched. Furthermore, exercises are undertaken to desensitize the speaker to the act of speaking and to stuttering. Such approaches can be used in people of all age groups who stutter (16, 24, 25).
- Combinations of speech restructuring and stuttering modifications are also effective. These can be used in children aged 12 or older and in adults (25, 26, e62). There are indications that children from age 9 may also benefit from such approaches (26, 27).
- In children, strong evidence supports the Lidcombe method, which is based on the principle of operant learning and is delivered in constant collaboration with the parents (28–31). Fluent speech is positively reinforced, and if stuttering events occur these are gently corrected. This method shall be used in children aged 3–6. It has shown robust long-term effects, as long as 7 years after the therapy (e63, e64). In Germany, it is provided by therapists with certified training.
- An indirect method uses parents' collaboration to create the individually required conditions in

TABLE 3

Efficacy of stuttering therapies available in Germany

Therapy	Description	Age range	Effect sizes*1	Recommendation*2
Speech restructuring (e.g. fluency shaping, Camperdown)	Learning new patterns of speaking (e.g. soft voice onset, prolonged speech) which can help prevent stuttering	From 12 y	FU 1 year: d = 1.40 and 1.37 for reduction in stuttering, for subj. scales comparable (20, 21); stuttering reduction: adults d = 0.75, adolescents 1.09; OASES adults 1.63; adolescents 1.36 (19)	**Shall** be used (strong recommendation)
		6–11 y	End of maintenance period d = 0.96 for 9–13-year olds (22)	**Can** be used (clinical consensus)
Lidcombe	Parents give systematic positive feedback for fluent speech, occasional gentle correction for stuttering event	3–6 y	FU 4 months: d = 1.00 (home measurement), 0.72 hospital measurement (31)	**Shall** be used (strong recommendation)
Indirect method	Parents are instructed to lower their communication challenges and adapt to the child's ability	3–6 y	N/A for effect sizes of reduction, but obviously large effects for FU 18 months (30)	**Should** be used (recommendation)
Stuttering modification	Stuttering events are addressed in order to overcome them quickly. Fluent parts of speech remain untouched	All	FU 2 years: stuttering reduction d = 0.56–0.65, depending on measure; subjective assessment d = 0.64–1.93 depending on scale (24)	**Can** be used (open recommendation)
Combination of fluency shaping/ stuttering modification	Speech restructuring and stuttering modification; sequence depends on symptoms	From 12 y	N/A	**Can** be used (open recommendation)
		9–11 y	N/A	**Can** be used (clinical consensus)
Gradual Increase in Length and Complexity of Utterance (GILCU)	Length and complexity of an utterance are increased sufficiently slowly for stuttering events not to occur	7–17 y	N/A	**Can** be considered (open recommendation)
Extended Length of Utterance (ELU)	The acoustic duration of individual syllables is increased via operant feedback	3–10 y	N/A	**Can be ignored** (open recommendation)
Pharmaceuticals	E.g. antidopaminergics, MAO inhibitors, anticonvulsants, GABA receptor modulators, calcium antagonists, parasympathomimetic drugs, substances affecting the cardiovascular system	All	If reported, then small; adverse effects frequent	**Shall not** be administered (strong recommendation)
Rhythmic speech		All	N/A	**Should not** be used as sole or predominant therapeutic component (recommendation)
Breathing control		All	N/A	
Hypnosis		All	N/A	**Should not** be used (recommendation)
Unspecified stuttering therapy	Therapeutic objective and approach not clear; therapeutic components not included in guideline; frequent treatment, mostly delivered by speech-language therapists; ususally extensive and individual treatement	All	N/A	**Should not** be used (recommendation)
Acceptance and Commitment Therapy (ACT)	Increasing awareness of emotional control; defusing and acceptance of stuttering events; self-assessment; awareness training	From 18 y	N/A re: effect sizes in paired comparison from before treatment to FU, although the effects seemed large; the only included study had methodological deficiencies (e.g. FU time period only 3 months)	**Should be forgone** (open recommendation)
Speech Motor Training	Positive reinforcement for responses using the correct voicing, soft flow of phonation, and appropriate speech tempo; stuttering is ignored	3–10 y	N/A	**Should be forgone** (open recommendation)
Affiliation to self help group		All	N/A	Recommendation (clinical consensus)

*1 Preferably German-language studies, if available; effect sizes calculated as Cohen's d; conventionally, effect sizes ≥ 0.20 are regarded as small, ≥ 0.50 as moderate, and ≥ 0.80 as large; y, year/s; N/A, not available; FU, follow-up

*2 For ease of understanding and to improve consistency, the wording of the guideline was slightly changed

which the child's speech fluency is intended to improve—for example, slowing down of the role model for speech, linguistic simplification, and a relaxed reaction to stuttering. This should be used in children aged 3–6. Strong evidence supporting this approach comes from a single Dutch study (30).

Medication treatments shall not be used (strong negative evidence [32]). Rhythmic speech and breathing control as the sole or predominant therapeutic components, hypnosis, and unspecified stuttering therapy without a recognizable concept should not be used (weak negative evidence). Further therapeutic approaches that should not be used are procedures that: (a) do not include measures ensuring the transfer into everyday life and generalization to different speaking situations; (b) do not include measures for dealing with relapse; (c) show short-term success but for which longer-term observational studies are lacking; (d) are based solely on breathing modifications or relaxation techniques; (e) allocate responsibility for causing the stuttering or potential relapses to the patient or their family; (f) promise a cure and do not comprehensibly describe treatment objectives and approaches.

Stuttering therapy should be offered independently of the affected person's age and onset of stuttering if impairments are present in the sense of the ICF. Stuttering children aged 3–6 shall be observed for a period of 6–12 months after onset of stuttering. Therapy shall be started if the stuttering persists after that period (33, e65). It shall, however, be started imminently if (a) several risk factors for persistent stuttering are present, (b) the key symptoms include long-term symptoms with loss of control and/or increased effort, and (c) the symptoms are experienced as stressful by the parent and/or child and cause avoidance behaviors.

In children, recovery from stuttering should be aimed for at age 3 to 6 years and the therapy should be completed before they start primary school, if possible. Complete recovery can, however, not be guaranteed. The simultaneous presence of a developmental speech-language disorder should not result in delaying indicated therapy for stuttering; if required, two treatments can be prescribed simultaneously.

In case of comorbidities, such as anxiety disorders and depression, the sequence of treatment should be prioritized (34). The exclusive treatment of stuttering-associated anxiety disorder does not reduce the frequency of stuttering and exclusive treatment of the speech fluency disorder does not reduce the anxiety disorder (35). Psychotherapy that does not address the problem of the speech fluency disorder directly should not be applied as the only treatment.

Devices and software that imposes a time meter for speech or that feed back the patient's own speech with a delay or changed frequency can eliminate stuttering during the period of their use (e66), but cannot be recommended as routine treatment components (e67). Software for improvement of speech fluency should be used only within the setting of recommended stuttering therapies and under the supervision of a therapist. Speech signal or electromyography (EMG) mediated biofeedback methods could be considered as a therapeutic component (36).

Participation in self-help groups—for example, through the Bundesvereinigung Stottern & Selbsthilfe (the Federal Association for Stuttering & Self-Help, BVSS, www.bvss.de)—is recommended on the basis of a clinical consensus.

KEY MESSAGES

- Originary non-syndromal stuttering is a neurogenic disorder of speech and speech planning, which develops in childhood primarily owing to a genetic predisposition.
- Misattributions of the causes of stuttering (psychological disorder, parenting style) are a problem that will have to be overcome by training of physicians, teachers and educators, and education of the public.
- Effective therapeutic approaches include the Lidcombe therapy and special indirect methods (age 3 to 6 years) as well as speech restructuring methods and stuttering modification, alone or in combination.
- Therapies based on medication or solely or primarily on breathing control or rhythmic speech are of unsatisfactory effectiveness, as are hypnosis and unspecified stuttering therapies.
- At the latest, therapies should start within the first 6–12 months after the onset of stuttering.

Cluttering

Cluttering is characterized by speech that is perceived as too rapid and/or irregular, and/or with irregularly occurring phonetic/phonological abnormalities, contraction or omission of syllables, abnormal pauses, syllable stress, and speech rhythm, as well as dysfluencies that are untypical for stuttering (37). These symptoms often impact the intelligibility of people who clutter. Etiologically, genetic factors have been assumed to be causal (38, e68, e69). Neuroimaging techniques and electrophysiological findings have shown cerebral anomalies in the speech–language relevant networks (e70). Differences between cluttering and stuttering are shown in *eTable 2*.

The Predictive Cluttering Inventory (e71) is available for the purpose of screening for cluttering. For the diagnostic evaluation, the medical history sheet by Sick (37) is available, as is the fluency assessment battery (39), and speech samples have to be audio(video)-recorded.. The few therapeutic studies have shown successes especially for speech restructuring strategies from stuttering therapy (40; see also *eTable 3*).

Needs for action and research

The guideline confirms the need for therapeutic research, among others, of the long-term effectiveness and efficiency of therapeutic approaches and their settings (individual therapy versus group therapy,

extensive versus intensive/interval therapy), of predictors for therapeutic success and relapses, of how to define effectiveness-oriented, evidence-based indications for different therapeutic methods, and of patients' reasons for deciding on certain therapeutic methods. The German remedies directives should be adapted to reflect the current state of knowledge.

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Conflict of interest statement
Dr. Sandrieser is in receipt of royalties for a book on the same topic from Thieme publishers.

Prof Bosshardt has received author fees for publications on the same topic from Hogrefe publishers.

The remaining authors declare that no conflict of interests exists.

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Supplementary material
For eReferences please refer to:
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eFigure, eTables:
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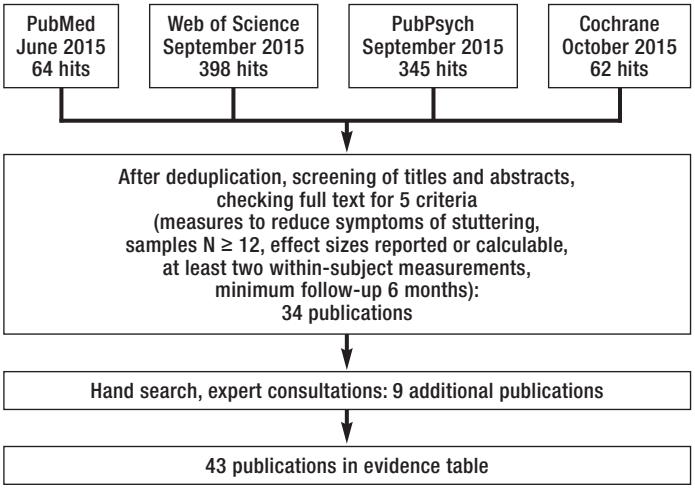
eFIGURE



Flow chart of literature search (since 2000) and selection for therapies for stuttering

Search filter PubMed: (((stutter*) OR (stammer*)) AND ((therapy) OR (treatment)) AND (outcomes))

Search filter Web of Science, Cochrane, and PubPsych: ((stutter*) OR (stammer*) OR (stotter*) OR ((disflu*) AND (speech)) OR ((dysflu*) AND (speech))) AND ((therap*) OR (stottertherapie) OR (treat*) OR (behand*) OR (manag*) OR (interven*) OR (clinical trial))

eTABLE 1

Specialist scientific societies, organizations, and mandate holders involved in the guideline*

Specialist scientific society	Mandate holder
Berufsverband der Kinder- und Jugendärzte e. V. (BVKJ, the professional association of pediatricians)	Dr. med. Burkhard Lawrenz
Berufsverband Deutscher Psychologinnen und Psychologen (BDP) und Sektion Klinische Psychologie im BDP (Association of German Professional Psychologists and section for clinical psychology within the association)	Prof. Dr. rer. nat. Christiane Kiese-Himmel
Bundesvereinigung Stottern und Selbsthilfe e.V. (BVSS, Federal Association for Stuttering & Self-Help)	Martina Rapp, M.A. Georg Thum, M.A.
Deutsche Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie e. V. (DGHNO, German Society of Oto-Rhino-Laryngology, Head and Neck Surgery)	Prof. Dr. med. Christopher Bohr
Deutsche Gesellschaft für Kinder- und Jugendmedizin e.V. (DGKJ, German Society of Pediatrics and Adolescent Medicine)	Dr. med. Thomas Mandel
Deutsche Gesellschaft für Kinder- und Jugendpsychiatrie, Psychosomatik und Psychotherapie e. V. (DGKJP, German Society for Child and Adolescent Psychiatry, Psychosomatic Medicine, and Psychotherapy)	Dr. med. Sarah Hohmann
Deutsche Gesellschaft für Neurologie (DGN, German Society of Neurology)	Prof. Dr. med. Martin Sommer
Deutsche Gesellschaft für Phoniatrie und Pädaudiologie (DGPP, German Society of Phoniatrics and Pediatric Audiology)	Prof. Dr. med. Katrin Neumann
Deutsche Gesellschaft für Psychologie e. V. (DGPs, German Psychological Society)	Prof. i. R. Dr. phil. Hans-Georg Bosshardt
Deutsche Gesellschaft für Sozialpädiatrie und Jugendmedizin e. V. (DGSPJ, German Society for Social Pediatrics and Adolescent Medicine)	Corinna Lutz, B.Sc. Dipl.-Psych. Benjamin Bleek
Deutsche Gesellschaft für Sprachheilpädagogik e. V. (dgs, German Society for Speech-Orthopedagogy)	Prof. Dr. phil. Christian W. Glück
Deutsche Gesellschaft für Sprach- und Stimmheilkunde e.V. (DGSS, German Society of Speech-, Language-, and Voice Pathology)	Prof. i. R. Harald A. Euler, PhD
Deutscher Berufsverband der Fachärzte für Phoniatrie und Pädaudiologie e. V. (DBVPP, German Professional Organization of Phoniatricians and Pediatric Audiologists]	Dr. Barbara Arnold
Deutscher Bundesverband der akademischen Sprachtherapeuten (dbs, German Federal Association of Academic Speech and Language Therapists)	Dr. phil. Stephan Baumgartner† Prof. Dr. phil. Volker Maihack
Deutscher Bundesverband für Logopädie e.V. (dbl, German Federal Association of Logopedics)	Dr. phil. Patricia Sandrieser, Peter Schneider
Gesellschaft für Neuropädiatrie (GNP, German Society for Neuropediatrics)	Prof. Dr. med. Thomas Lücke
Interdisziplinäre Vereinigung der Stottertherapeuten e. V. (ivs, German Interdisciplinary Association of Stuttering Therapists)	Susanne Cook, PhD Christine Metten, PhD
Moderation and advice	
Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF, Association of Scientific Medical Societies in Germany)	Prof. Dr. Dr. med. Ina Kopp

* Publisher: German Society of Phoniatrics and Pediatric Audiology (DGPP), represented by Prof. Dr. med. Katrin Neumann
(Modified from [4]; with permission from Peter Lang AG International Academic Publishers)

eTABLE 2

Distinguishing characteristics of cluttering and stuttering (37, 39)

	Characteristic	Cluttering	Stuttering
	Time course	Continuous, but may be jerky, mostly without accompanying symptoms	Often fluctuating, accompanying symptoms are common
Obligatory	Rate of speech	Mostly increased and/or irregular	Mostly not increased
	Repetitions	Primarily repetitions of words and of parts of sentences	Repetitions of sounds, word parts, and monosyllabic words
	Prolongations and blocks	Not present	May be present
	Phonetic-temporal and/or phonologic abnormalities	Usually present (e.g. elisions, contaminations, mumbling)	Occasionally present (coping strategy)
	Prosody	Often unadjusted intonation and word accent, monotonous speech, limited variability differences in speech melody	Abnormality may be present as inappropriate coping strategy (e.g. changes in pitch during the struggle to start speaking)
Optional	Lexicon, semantics	Occasional difficulty in word retrieval, or mild semantic-lexical difficulties	Not impaired
	Speech structuring	Unstructured speech is common (mental leaps), abnormalities in coherence and cohesion	Occasionally impaired (coping strategy)
	Attention deficit disorder	Auditory vigilance impairment cannot be ruled out	Not impaired
	Adaptation effect	Mostly not observed	Mostly observed
	DAF (Lee effect)	Mostly more dysfluent speech	Mostly more fluent speech
	Self-perception	Limited perception of symptoms, low speech control	Present (in older children, adolescents, and adults)
	Psychosocial stress	Occasionally present stress caused by lack of acceptance and possible stigmatization by the social environment	Frequent reaction to stuttering (fear, shame)
	Pragmatics	Difficulty in surrendering the role of main speaker, in ensuring comprehension, and in clearing up misunderstandings	Not affected or peculiarities due to avoidance coping
	Reading	Occasionally difficulty in segmenting words, omissions of words, passages, or lines	Core and accompanying symptoms similar to those observed in spontaneous speech
	Writing	Poor spelling possible, transpositions, commutations, blending	Not affected

(Adapted from [4]; with permission from Peter Lang AG International Academic Publishers)
DAF, Delayed Auditory Feedback

eTABLE 3

Treatment of cluttering

Target	Intervention
Speech rate	To be addressed during treatment; NB: isolated slowing down of speech does not generally improve articulation
Speech fluency	Speech restructuring: fluency shaping; cluttering modification (36)
Phonetics, articulation	Systematic training by hierarchically increasing linguistic complexity, Oral Motor Syllable Training Program (e80), kinesthetically controlled speech (e81)
Prosody	Addressing word and sentence accent, inserting sensible pauses, speech rhythm, intonation, intentional (non-spontaneous) speech
Syntax/morphology	For children: practicing morphologic-syntactic target structures For adolescents and adults: focus on coherence and cohesion in complex sentence patterns (36, p 170)
Semantics/lexicon	Learning individual strategies to structure utterances, for example, by retelling, picture stories, describing terms (36, p 171ff.)
Speech structure	Strategies for coherent expressions, structuring the components of utterances sensibly
Self-perception	Identifying symptoms, mirroring, analysis of audio and video recordings
Pragmatics	Non-verbal support (gestures, facial expressions), identifying non-verbal communications by the communication partner and listening behavior, practice of turn-taking
Relatives and environment	Including the reference person (in children and adolescents) and – if accepted by all involved – other persons (in adults)

(Adapted from [4]; with permission from Peter Lang AG International Academic Publishers)