RCSLT

Position paper on Childhood Apraxia of Speech (CAS)

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Contents

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The 2011 project team were:

- Dr Jan Broomfield (DVD Policy Statement Lead)
- Maria-Loukia Bratsou
- Maria Luscombe
- Claire Madeira
- Dr Pam Williams

The 2024 project team were:

- Dr Helen Stringer (Lead author)
- Dr Jan Broomfield
- Shula Burrows
- Claire Madeira
- Dr Pam Williams

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Introduction

This document has been developed primarily for the speech and language therapy workforce. Other professional groups and organisations together with parents, families and carers will find this to be a useful, relevant and informative resource. Speech and language therapy specific terminology has been used in this document and if further explanation or guidance is needed, please discuss this with a speech and language therapist.

Some of the resources linked in this document are only accessible to RCSLT members. For further information on the purpose of RCSLT guidance, please see: how we develop our guidance.

Terminology

Childhood Apraxia of Speech (CAS) is a rare motor speech disorder which reduces the intelligibility of speech. It is a subtype of the diagnostic category Speech Sound Disorders (SSD). Prior to 2024, in the UK, Childhood Apraxia of Speech (CAS) was known as Developmental Verbal Dyspraxia (DVD). However, the term CAS is now adopted in the UK, replacing DVD in all contexts, to align with the established international terminology. This change in terminology will benefit individuals with CAS, their families and speech and language therapists (SLTs). As the term CAS is used in all research and the majority of online information and support, this change will facilitate access to appropriate online information for individuals with CAS and their families and SLTs' access to the rapidly growing evidence base.

Position paper update

This position paper replaces the *2011 Policy Statement on Developmental Verbal Dyspraxia*, which was produced by a project team of consultant and specialist SLTs from across the UK. This 2024 Position Paper, by a group of expert SLTs, reflects the current context and evidence base. The updated document was supported through a consultation process with the RCSLT membership, international researchers, and experts by experience (e.g. parents, caregivers).

Where references to external sources are made (see in-text citations and references), these are current at time of writing. It is expected that SLTs will access evidence published after 2024 and visit recommended online resources. Resources to support critical appraisal of literature are freely available e.g. The Oxford Centre for Evidence-Based Medicine, The Critical Appraisal Skills Programme and the JBI. There are additional resources for RCSLT members.

Aim and scope

The aim of this document is to offer guidance regarding children with CAS for:

- SLTs and managers of SLT services in order to influence commissioning arrangements and plan service delivery
- Higher Education Institutions (HEIs) for the purposes of pre-registration and postgraduate education and academic research
- organisations committed to providing or determining appropriate provision and support for individuals with CAS.

It includes:

- Key strategic and policy drivers that influence practice
- Values embedded within SLT practice
- Roles and responsibilities of SLT practice

Associated guidance

This document should be read in conjunction with other key RCSLT resources, including:

- RCSLT guidance on speech sound disorders
- RCSLT guidance on delivering quality services
- RCSLT guidance on children's services
- RCSLT guidance on education
- RCSLT guidance on AAC

Background

Although CAS is a low prevalence condition, it has a serious and long-lasting impact. It is present from birth and will not resolve without specialist speech and language therapy intervention. The evidence base continues to grow rapidly and as we learn more about CAS through epidemiological, diagnostic and intervention research, we can be more confident in assessment, diagnosis and intervention. It is essential that SLTs maintain up to date knowledge of the evidence base for CAS as this continues to evolve. An evidence summary is produced on a regular basis by McCabe and colleagues at the University of Sydney, Australia, which is recommended as a starting point (McCabe et al., 2024) to more in-depth engagement with the evidence and theory related to CAS. In addition, there is an extensive reference list at the end of this document.

Prevalence and incidence of SSD including CAS

Approximately 10% of children in the UK have speech and language difficulties, making this the most common developmental problem faced by young children (Public Health England, DfHSC and DoE, 2020). SSD is an overarching term that encompasses a number of subtypes that include disorders associated with biomedical conditions such as cleft palate and disorders of unknown origin including phonological delay and disorder. Both the American Speech Language Hearing Association (ASHA) (2007) and RCSLT SSD clinical guidance (2024) acknowledge that CAS exists as a subtype of SSD.

For children aged 3-11 years the reported prevalence of SSD is between 3.4% and 8.4% (Broomfield & Dodd, 2004; Choo et al., 2022; Eadie et al., 2015). The prevalence of CAS is estimated to be 0.1% (Baylis & Shriberg, 2019) or 1 child per 1000. The incidence of children with primary SSD referred to speech and language therapy services each year is approximately 30% (Broomfield & Dodd, 2004). Between 80% and 90% of these children will have a phonological disorder or delay and between 0.2% and 2.4% will have CAS (Baylis & Shriberg, 2019; Broomfield & Dodd, 2004). However, there is a greater incidence of CAS in children with known neurodevelopmental conditions e.g. 4.3% for CAS alone and 4.9% for concurrent CAS and childhood dysarthria (Shriberg et al., 2019).

Long term Impact of SSD including CAS

Children who present with SSD, including CAS, may be unintelligible even to familiar listeners. Therefore, as well as requiring remediation of their specific difficulty, they require support to communicate and interact effectively with those around them. Speech and language difficulties are known to impact learning and literacy and, if persisting into later childhood, peer relationships and social-emotional wellbeing (Wren et al., 2021, 2023). Additional support, beyond that provided by SLTs, is required in educational settings as well as within social and family contexts. In these circumstances it may be appropriate for the SLT, another involved professional or a family member to advocate for the child.

Children with CAS must be included in SLT service planning, design and reconfiguration, regardless of the sector from which the commissioners originate. They will require a different care pathway to children with other subtypes of SSD. CAS is acknowledged as a long-term condition with potential life-long consequences. Older children, adolescents and adults are likely to experience greater negative impact than younger children, due to a previous lack of access to appropriate and/or sufficient intervention (McCabe et al., 2024). SSD, including CAS, may continue to impact upon individuals into adolescence (Lewis et al., 2021) and into adulthood (Cassar et al., 2022), hence lifelong provision and support may be required from social care settings as well as across health, education and the voluntary and independent sectors. Providing appropriate high-quality interventions at an early stage will reduce demand on future services.

Childhood Apraxia of Speech

Aetiology

In the majority of cases, the cause(s) of CAS remains unknown. Descriptions of CAS have universally ascribed its origin to neural inefficiency of sensori-motor processing (McCabe et al., 2024; Strand, 2020). Research involving MRI brain scans of individuals with CAS has, in some cases, identified disruption of the dorsal language stream as a novel neural phenotype of SSD, distinct from that reported in SSD associated with FOXP2 gene variants (Liégeois et al., 2019). There is also evidence of an increasing number of genetic variations related to CAS, with or without family histories reported (Lewis et al., 2004, 2011; McCabe et al., 2024; Morgan & Webster, 2018; Shriberg, Potter, et al., 2011; Peter et al., 2014).

The genetic origin of some cases of CAS was first identified in pathogenic variants of the FOXP2 gene (Lai et al., 2001). Currently, approximately one third of identified cases of CAS are known to have a genetic aetiology, with a large number of different genes implicated (Eising et al., 2019; Hildebrand et al., 2020; Kaspi et al., 2023). Some of these are already linked to existing neuro-developmental disorders (Laffin et al., 2012; Kaspi et al., 2023). A family history of CAS is not always present even when a genetic disorder is identified. It is likely that further research in this area will increase the number of identified cases of genetic origin and lead to epigenetic interventions. Up to date information about genetic causes of CAS can be found at the Murdoch Children's Research Institute Translational Centre for Speech Disorders.

Although there are some parallels, CAS is considered a different condition to apraxia of speech (AOS) in adults, as it has an impact on the development of higher level phonological and linguistic processing (Maassen, 2002).

CAS can occur in 3 clinical contexts (ASHA, 2007, p. 2):

1. It occurs as a primary or secondary sign in children with complex neuro-behavioural disorders of genetic origin (e.g. Down syndrome, autism, epilepsy, galactosaemia).
2. It occurs as an idiopathic neurogenic speech sound disorder, in the absence of any known neurological or complex neuro-behavioural disorder.
3. It is associated causally with known neurological aetiologies such as intrauterine stroke, infections, trauma.

Genetic mapping and brain scanning

Investigation into genetic or neurological aetiology is usually requested by a paediatrician. Indicators for onward referral to a paediatrician, if one is not already involved, include co-occurring conditions, unusual presentation (physical, cognitive, neuro-behavioural etc.). Presence or absence of family history is not a clear indicator for genetic mapping and should not be the deciding factor for onward referral. The reason for referral to a paediatrician must be clearly explained to parents (i.e. adults with parental responsibility), including the benefits and risks of further investigation. Fully informed consent must be obtained for referral to a paediatrician. Referral to a paediatrician can be made by the child's GP/family doctor. In most cases the outcome of further investigation, including identification of a specific gene, will not change speech and language therapy management, which should continue whilst the child is progressing through further investigation.

Characteristic features of CAS

Childhood Apraxia of Speech is a childhood neuro-processing speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits (e.g. there are no abnormal reflexes or abnormal tone). The core impairment in planning and/or programming the spatio-temporal parameters of movement sequences results in errors in speech sound production and prosody (ASHA, 2007).

"Sensorimotor planning for speech involves establishing the spatial and acoustic goals, while sensorimotor programming for speech refers to the actual specification of movement parameters (i.e., instructions for the timing of muscle contraction so that specific structures move in the right direction, at the right time, with the right speed and force to reach a specific articulatory configuration)" (Strand, 2020, p. 31).

ASHA (2007, p. 54) advised that a minimum of three segmental and supra-segmental consensus based features are met in order for a child to be diagnosed with CAS. These are:

- inconsistent errors on consonants and vowels in repeated productions of syllables or words
- lengthened and disrupted co-articulatory transitions between sounds and syllables
- inappropriate prosody, especially in the realisation of lexical or phrasal stress.

These features reflect both segmental (e.g. sound) and supra-segmental (e.g. word and syllable) levels, indicating a deficit in the planning and programming of movements for speech. These three signs have been subsequently validated in a factor analysis of signs of CAS (Chenausky et al., 2020).

Table 1 lists the characteristic features of CAS. The characteristics/features listed in the first column are extracted from the ASHA (2007) Position Statement and what is known as the Mayo-10 Checklist (Shriberg, Potter and Strand, 2011) or are reported elsewhere in the CAS literature. It should be noted that some of these characteristics are not only seen in CAS but may be indicative of other diagnoses, including dysarthria, hence accurate differential diagnosis is essential (Strand, 2020; Iuzzoni-Seigal et al., 2022).

A child with CAS typically presents with difficulties in any or all of the following domains: non-speech motor behaviours, motor speech behaviours, speech sounds and structures (words and syllable shapes), prosody, language, meta-linguistic/phonemic awareness and literacy (ASHA, 2007).

Table 1. Characteristic Features of CAS

Characteristic/Feature[1]	**Description/notes**	**Source**
Lengthened & disrupted co-articulatory transitions between sounds & syllables	May present as slow, distorted or staccato speech; awkward movements may be visible	ASHA consensus Mayo -10
Inappropriate prosody, especially in the realization of lexical or phrasal stress	May present as equal or inappropriate stress patterning. NB Intonation, rhythm & rate may also be affected	ASHA consensus Mayo-10
Inconsistent errors on consonants and vowels in repeated productions of syllables or words	NB need to differentiate from inconsistent phonological disorder. Minimally verbal children with severe CAS may not be inconsistent as they have difficulty changing any movement parameter & have a very limited speech sound repertoire	ASHA consensus
Groping & or trial & error behaviour	Groping, silent posturing or searching articulatory behaviours may be seen	Mayo-10
Presence of vowel and/or consonant distortions	Vowels may not be clearly identifiable. They may sound like they are 'in between' two vowels. Consonants may not be clearly identifiable due to blending of manner (e.g. in between /m/ and /b/)	Mayo-10
Inconsistent voicing errors	Voicing errors are present; it may be difficult to identify whether a sound is voiced or unvoiced, due to mistiming of onset of vocal fold vibration	Mayo-10

Characteristic/Feature[1]	Description/notes	Source
Intrusive schwa	An additional schwa is added either in word final or within word positions	Mayo-10
Syllable segmentation	Gaps between sounds, syllables or words	Mayo-10
Slow rate of speech		Mayo-10
Slow DDK rate		Mayo-10
Increased difficulty with longer or more phonetically complex words	Marked differences may be seen in accuracy of monosyllabic and polysyllabic words	Mayo-10
Limited consonant and vowel repertoire	As single sounds and/or when used in words	Other
Use of simple syllable shapes		Other
Frequent omissions of sounds		Other
Poor intelligibility		Other
Numerous errors leading to poor standard scores on tests of articulation & phonology		Other
Fluctuating resonance/intermittent hyponasality or hypernasality may occur	Likely to be due to poor control/mistiming of the velopharyngeal sphincter. NB need to rule out structural and/or neuromuscular explanation	Other
Atypical voice quality	Likely to be due to poor control/mistiming of the vocal folds. NB need to rule out vocal pathology	Other
Oral motor difficulties	Oral motor apraxia may/may not co-occur with CAS; early feeding and drooling difficulties may persist	Other
Delayed early speech skills	Late onset or absence of babble	Other
General motor co-ordination difficulties	Developmental co-ordination disorder may co-occur	Other

Characteristic/Feature[1]	Description/notes	Source
Language difficulties	Receptive and particularly expressive language difficulties may co-occur; Morpho-syntactic difficulties have been reported	Other
Phonological awareness and literacy difficulties		Other
Family history of speech, language & literacy difficulties		Other

[1]Based on: American Speech-Language-Hearing Association, 2007; Goldstein & Fabiano, 2007; McCabe et al., 2024; Murray, McCabe, Heard, et al., 2015; Murray et al., 2021; Shriberg, Potter, et al., 2011; Strand, 2020; Williams & Stephens, 2004

Change over time

It is recognised that the presenting characteristics of CAS often change over time. This change occurs in relation to the characteristic presenting features, impacting on severity, which tends to reduce over time in response to intervention. CAS can be present to any degree from mild to severe and can have increasing impact on individuals as the demands of communication increase. McCabe et al., (2024, p. 2) suggest the following factors to determine severity of CAS:

> "1. Intelligibility – children with more severe CAS will struggle to be intelligible even to immediate family.
> 2. Speech inventory (number of sounds and syllable structures) in comparison to other people of the same chronological or language age.
> 3. Number of features of CAS present and severity of features. These lists of features come from two sources (ASHA, 2007 and Shriberg, et al., 2011).
> 4. In older children, adolescents, and adults: Difficulty saying new or longer words, avoiding speaking tasks such as using the phone, social isolation, or reduced quality of life.
> 5. Presence of other communication or cognitive issues."

It is recognised that the reported signs of CAS change in their relative frequencies of occurrence with task complexity, severity of involvement and age. For example, ASHA (2007) state that the complex behavioural features reportedly associated with CAS place a child at increased risk for early and persistent problems in speech, expressive language and the phonological foundations for literacy, with the possible need for augmentative and alternative communication and assistive technology.

As its presentation may change over time, additional challenges may arise. It may be that those progressing from a severe to a mild difficulty are those who have responded to therapy input; unfortunately, there is insufficient data to determine this at the current time.

Clinical management of CAS

Access to speech and language therapy services

There is currently variation of access to specialist SLTs across the UK. In some areas, an SLT who has significant experience and some post-graduate training in SSD provides advice and guidance as well as second opinions for less experienced and generalist SLTs. They also lead the management of these complex cases. In other areas, no such specialist exists. In the UK, there is one national specialist centre specifically for children presenting with potential CAS. This is the NHS Paediatric Speech Clinic at Royal National Ear Nose and Throat and Eastman Dental Hospital (RNENT), previously known as the Nuffield Speech Clinic. The service at the Paediatric Speech Clinic at the RNENT hospital provides second opinion assessments, reports specifying the child's speech and language therapy needs and some time-limited treatment for children referred by local professionals. Some other local NHS services provide specialist provision for individuals with CAS in their locality. There are also several educational placements and school settings throughout the UK specifically providing for children with severe/specific speech and language impairment with high levels of input from SLTs.

Regardless of the educational placement of the children, it is essential that there is coordination between the SLTs, the family and teaching staff, in order that the educational impact of CAS can be minimised. This is particularly the case for differentiated access to the curriculum and the development of literacy skills.

RCSLT (2024) and ASHA (2007) advise that SLTs are responsible for making the primary diagnosis of CAS and for designing and implementing the appropriate individualised speech and language treatment programme. ASHA (2007, p. 38) explicitly state that the SLT involved should have specific experience in paediatric speech sound disorders, including motor speech disorders. When children present with CAS in complex neuro-behavioural conditions or co-occurring presentations, there should ideally be a multidisciplinary team involved alongside the SLT, for example medical practitioners, teaching staff, psychologists, physiotherapists, occupational therapists and audiologists.

There are several ways for SLTs to access support and specific CPD related to CAS. These include RCSLT Clinical Advisers; the RCSLT SSD Clinical Excellence Networks (CENs) which are based regionally throughout the UK; the Paediatric Speech Clinic at the RNENT hospital and professional CPD providers. In addition, the Paediatric Speech Clinic at the RNENT hospital provides advice to SLTs on individual cases.

Assessment

Assessment protocols

Children with any presentation of SSD should initially be assessed following the RCSLT SSD Assessment guidelines. This will include a case history, hearing and language assessment. The Diagnostic Evaluation of Articulation and Phonology (DEAP) (Dodd et al., 2002) is recommended. Assessment of children with CAS should take into account their age, the severity of their SSD and any known or suspected co-occurring conditions (McCabe et al., 2024; Murray, McCabe, Heard, et al., 2015).

The McCabe et al., (2024) Evidence Summary - Childhood Apraxia of Speech is updated regularly and is recommended as an evidence-based source for suggested assessment protocols for CAS. It is acknowledged that assessment in English is most straightforward due to the tools available. However, similar tasks are required for languages other than English and SLTs are advised to work closely with interpreters to formulate suitable tasks. See also RCSLT guidance on bilingualism and working with interpreters.

Different assessment protocols are recommended for younger children or those with more severe speech disorders compared to older children or those with less severe speech disorders (McCabe, 2024). SLTs are advised to follow these to ensure the appropriate range and depth of information is collected to inform differential diagnosis. As CAS is typically identified by speech output characteristics, it cannot be identified with confidence until the child has some spoken output and the SLT can find evidence of indicative speech and prosodic features. If the child has little or no functional verbal communication and is unable to attempt imitation, it may not be possible to conduct a definitive assessment at this stage (see RCSLT SSD Assessment guidance).

Assessment tools

A range of formal assessments are available that contribute to the stringent requirements for differential diagnosis of CAS (see also McCabe et al., 2024; Murray, McCabe, Heard, et al., 2015; Terband et al., 2019).

These include:

1. The DEAP (Dodd et al., 2002) is a standardised assessment that provides a range of sub-tests which not only facilitates detailed phonological analysis, but also supports differential diagnosis of output phonological processing difficulties. The assessment begins with a brief Diagnostic Screen, incorporating naming of 10 single word pictures, imitating all sounds produced in error, and re-naming the 10 pictures; this allows a rapid analysis of the SSD and signposts more detailed assessment through the DEAP subtests.

DEAP subtests comprise an articulation assessment (picture naming, sound and syllable imitation), oromotor and DDK assessment (movement and sound production and sequencing), phonology assessment (picture naming at single word and sentence levels, supported by phonological analysis and PCC standardised scoring) and inconsistency assessment (25 pictures to be named 3 times each). The DEAP is currently the only assessment for SSD that is standardised on a UK population.

2. The Nuffield Dyspraxia Programme Assessment is a component of the Nuffield Centre Dyspraxia Programme-3rd edition (NDP3) (Williams & Stephens, 2004). It assesses production of consonants and vowels in isolation, single words of different phonotactic structures, phrases and sentences. Oromotor skills and diadochokinetic skills (DDK) are also assessed. The assessment allows for the identification of segmental and supra-segmental features of CAS, thereby contributing to the differential diagnosis. The profile of skills demonstrated at different levels of phonotactic structure can be used to plan intervention, and links into resources in the NDP3 (Williams & Stephens, 2004, 2010).

3. The Dynamic Evaluation of Motor Speech Skill (DEMSS) (Strand et al., 2013; Strand & McCauley, 2019) is suitable for younger children and those with more severe disorders, including children with little or no functional verbal communication who can attempt imitation. The DEMSS comprises eight subtests and 60 utterances. Scoring considers overall articulatory accuracy, vowel accuracy, prosodic accuracy (lexical stress) and consistency through 186 scoring judgements across these four areas. The DEMSS uses dynamic assessment techniques (Lidz, 1991; Lidz & Pena, 1996) in which multiple attempts are elicited for scoring as the SLT cues, scaffolds and uses other techniques (e.g., slowed rate or simultaneous production) to facilitate performance and obtain information about the child's zones of actual and proximal development (ZAD and ZPD). This allows observation of groping, segmentation, timing errors or other characteristics of CAS and facilitates judgement of severity (Strand et al., 2013). The dynamic nature of the DEMSS also facilitates choice of the content and complexity of stimuli for early stages of intervention.

4. The Compendium of Auditory and Speech Tasks (Stackhouse et al., 2007) provides the psycholinguistic framework and assessments needed to draw up a child's speech processing profile as a basis for intervention and prediction of possible outcomes. These tasks include auditory discrimination of real and non-words and words in sentences; mispronunciation detection tasks to investigate lexical representations; speech production of real and non-words in naming and repetition tasks; connected speech assessment; and diadochokinetic tasks. Data from typical children aged 3-7 years are included for comparison and a CD Rom provides the picture stimuli needed.

Differential Diagnosis

Children must have a clear intent to communicate for a diagnosis of CAS to be considered, regardless of age or severity of disorder. For some children with severe SSD, differential diagnosis of CAS may be an evolving process as the stages of the assessment protocol reveal more detailed information and the child produces more verbal output. If there is uncertainty regarding the diagnosis, then "suspected CAS" or a statement to say CAS cannot be ruled out or in, is acceptable.

However, it is essential at this point that other conditions such as submucous cleft and inconsistent phonological disorder have been conclusively ruled out. These both require different interventions to those recommended for CAS. Lack of definitive diagnosis for children with severe and persistent SSD should not be a barrier to intervention as response to intervention can provide additional assessment information. It is the responsibility of a suitably qualified and experienced SLT to diagnose CAS, following detailed assessment (ASHA, 2007; McCabe et al., 2024; Murray, McCabe, Heard, et al., 2015). See RCSLT SSD Diagnosis guidelines.

Severity of CAS can be rated using scores from the DEMSS, if available, or standard scores on other assessments e.g. PCC in the DEAP, articulation assessments, observation of the number and frequency of CAS characteristics (Chenausky et al., 2023).

Risk of over-diagnosis

SLTs should show caution when diagnosing CAS. There is a tendency for SLTs to over diagnose CAS (Murray et al., 2021) thereby denying children appropriate effective intervention and potentially causing harm. It is essential that detailed assessment is conducted so that conditions such as submucous cleft palate, dysarthria, inconsistent phonological disorder and severe language disorder can be definitively ruled in or out.

Over-identification of CAS by SLTs is confirmed in the literature, where second assessments by researchers or clinical experts reject the initial diagnosis of CAS. This is evidently a long-standing issue, with literature going back into the twentieth century.

Out of a sample of 47 children identified by community SLTs as having CAS, Murray et al., (2015) confirmed 28 as having CAS, a further four with CAS plus dysarthria and language disorder, 15 without CAS but with submucous cleft, phonological disorder or dysarthria that was going untreated. Stringer and Nicholson (2011) found that only 1 of 7 of cases with CAS identified by SLTs were confirmed; McNeill et al., (2009b) confirmed the diagnosis in only 12 out of 44 suspected cases; Moriarty and Gillon (2006) confirmed three out of 10 referred children; Davis et al., (1998) identified four out of 22 potential cases. Adherence to clear diagnostic indicators (see table 1) and detailed appropriate assessment for all subtypes of SSD should make this issue a thing of the past. CAS vs. Inconsistent Phonological Disorder

Inconsistent production at a lexical level is the primary feature of Inconsistent Phonological Disorder (IPD) (Dodd, 2014) as well as being a key feature of CAS, and the two presentations may be confused in clinical contexts leading to inappropriate intervention. However, application of the three consensus based features of CAS (see above) (ASHA, 2007), will facilitate differential diagnosis (see Williams & Broomfield, 2019 for more detail).

CAS vs. expressive language difficulty

There is a need to differentiate between young children presenting with features of CAS from those presenting with an expressive language disorder, particularly when these children are at a pre-verbal stage (Broomfield & Dodd, 2005). As the child develops a diagnosis of CAS or expressive language disorder may become more evident. However, some children may have co-occurring expressive language disorder and CAS.

CAS vs. slow response to intervention

Caution should be applied when children presenting with SSD are resistant to change in response to intervention over a period of time. The first step in such cases should be to return to assessment data to ensure they were accurately interpreted and met the needs of the child. It may be necessary to repeat assessment or assess in other areas if the child has shown signs of development or there have been advances in assessment tools or protocols. Appropriate intervention should then be remapped onto the assessment data. Anecdotally, some of these children are diagnosed with CAS as a default position because of a lack of change. It is acknowledged that for many children with CAS, progress may be slow in response to intervention, due to its complex nature. However, diagnosis of CAS cannot be made based on the single characteristic of resistance to change in intervention, the child must at a minimum meet the three ASHA (2007) consensus-based features (see above).

CAS vs. dysarthria

Differential diagnosis of CAS and developmental dysarthria can be particularly difficult as not only do they share some characteristics in speech, voice and prosodic features but they can co-occur. Dysarthria is caused by an underlying motor disorder. It is not possible to make a differential diagnosis between CAS and dysarthria from auditory perceptual characteristics alone, but an oral motor examination is also required. Oromotor disorder may be evident from observation of the child's face, their control of isolated and combined oral movements and reduced saliva control, eating, drinking and swallowing difficulties. SLTs working with children with severe, complex SSD, including CAS, should refer to Iuzzini-Seigel, Allison & Stoeckel's (2022) 'A Tool for Differential Diagnosis of Childhood Apraxia of Speech and Dysarthria in Children: A Tutorial.'

Co-occurring conditions

In addition to the conditions that co-occur with SSD in general (e.g. literacy, phonological processing), CAS can co-occur with other conditions. In each case detailed assessment and careful differential diagnosis is required to ensure signs of SSD subtypes, including CAS, are not masked or mirrored by symptoms or characteristics of the condition and in all cases, there is intent to communicate. Conditions where CAS is known to co-occur include:

- Down Syndrome (Kumin, 2006; van Bysterveldt et al., 2010)
- the metabolic disorder galactosaemia (Shriberg, Potter, et al., 2011)
- epilepsy, although careful differential diagnosis with dysarthria is required (Allison et al., 2023; ASHA, 2007; Morgan & Webster, 2018)
- various genetic variations where genes are identified as related to CAS (Eising et al., 2019; Hildebrand et al., 2020; Kaspi et al., 2023.) See Morgan & Webster (2018) for a comprehensive overview
- 22q11.2 deletion syndrome (Baylis & Shriberg, 2019), 16p11.2 deletion syndrome (Morgan & Webster, 2018; Mei et al., 2018)
- dsevelopmental dysarthria e.g. Worster Drought syndrome.

There is some literature that suggests CAS frequently co-occurs with autism. However, there is robust evidence that the fine motor deficits that impact speech production of some autistic children are different in nature to those that underlie CAS (Mody et al., 2017; Shriberg, Paul, et al., 2011; Talkar et al., 2020). It is therefore important to take this into account when assessing autistic children's speech. An assumed diagnosis of CAS cannot be made if the child does not use enough spontaneous words to support a full assessment. Furthermore, the prevalence of CAS in autistic children is the same as for the general population (McCabe et al., 2024).

Children with CAS may also have non-verbal oral apraxia, which affects their ability to make and co-ordinate the movements of the larynx, lips, tongue and palate for activities other than sound production such as blowing, sucking and licking. Furthermore, they may also have limb or generalised dyspraxia which affects control over gross and fine body movements; these latter movement difficulties may be described as Developmental Co-ordination Disorder (DCD) by some professionals, particularly physiotherapists, occupational therapists and paediatricians (Iuzzini-Seigel, 2019). The presence of non-verbal oral apraxia and/or DCD in a child suspected to present with CAS is likely to give support for the classification. However, caution is advised when considering identification of this symptom cluster in young, particularly pre-lingual children.

Intervention

Readiness

As with other subtypes of SSD, children with CAS may not have the necessary skills to benefit from the intervention when they are first referred, assessed or diagnosed. The intensity and focus of all interventions for CAS requires that the child has intention to communicate, can establish joint attention, discriminate speech from background noise, intentionally change focus of attention and take turns in an activity. In some cases, support for parents/caregivers may be required so that these skills can be reinforced on a daily basis. This may be before recommended intervention that directly targets speech can begin.

For children with CAS, intervention should begin early, with one main focus which will change as other skills emerge. For example, the focus may move from communication strategies, communication pre-cursors (e.g. attention & turn-taking) and vocalisation to motor planning drills, phonological awareness or literacy, as the child develops.

Recommended evidence based interventions

The most fundamental life skill for children is the ability to communicate. It directly impacts on their ability to learn, to develop friendships and on their life chances' (Bercow, 2018, p. 4). This statement forms the basis for the vision and values for the management of those with CAS, in which we aim to maximise each individual's potential by optimal management of their presenting communication disability.

Children with CAS can show improvement when provided with the appropriate effective intervention in the correct quantity and frequency (McCabe et al., 2024; Morgan et al., 2018; Murray et al., 2014). There are five recommended interventions supported by evidence of effectiveness in ameliorating CAS. Other interventions have weak evidence from a small number of participants with CAS (e.g. Dale and Hayden, 2013) and should be undertaken with caution and a clear justification related to the child's assessment data. Some interventions have no evidence of effectiveness for children with CAS and should be avoided, even if they are effective with children who do not have CAS. SLTs should regularly monitor newly published research for robust evaluations of interventions for CAS. Interventions for adults with apraxia of speech are not suitable for use with children due to the different origin and consequences of these two conditions.

These five recommended interventions have more robust evidence, the target population is indicated below. All of them have research evidence and associated resources and CPD available.

1. Rapid Syllable Transition Treatment (ReST) (Lim et al., 2019; McCabe et al., 2020; Thomas

et al., 2014). Tutorials and therapy resources are available from Rest Sydney (accessed Jan 2024). ReST is suitable for older children and those with less severe disorders.

2. The Nuffield Centre Dyspraxia Programme 3rd edition (NDP3) (Murray, McCabe, & Ballard, 2015; Williams & Stephens, 2004, 2010). NDP3 is suitable for younger children and those with more severe disorders. Information about resources and training are available from NDP3 . (2024)

3. Dynamic Temporal and Tactile Cueing (DTTC) (Strand, 2020; Strand & Mccauley, 2019). DTTC is suitable for younger children and those with more severe disorders. Further information and tutorials are available from Child Apraxia treatment (2024)

4. Integrated phonological awareness (IPA) (McNeill et al., 2009c, 2009a). IPA is suitable for older children and those with less severe disorders. An intervention manual (Gillon and McNeill, 2007) is available on the University of Canterbury's website.

5. Ultrasound biofeedback (Cleland et al., 2015, 2019; McCabe et al., 2023; Preston et al., 2013; Sugden et al., 2019). Ultrasound biofeedback is more suitable for primary school aged and older children. Research papers by Preston et al. and video examples of use can be found on Syracuse University's Speech Production Lab (2004). Availability of ultrasound may be limited due to the cost of the specialist equipment required.

Augmentative and alternative communication (AAC)

AAC may be used to support everyday communication for children with CAS alongside the interventions above (Leonet et al., 2022; Murray et al., 2014; Oommen & McCarthy, 2015). See RCSLT AAC guidance for more information.

Non-speech oro-motor exercises (NSOMEs)

There is no evidence that non-speech oro-motor exercises have any beneficial effect for children with SSD, including CAS (ASHA, 2007; Lee & Gibbon, 2015; McCauley et al., 2009; Ruscello, 2008). CAS involves deficits in the planning and programming of speech movements (Case & Grigos, 2016; Grigos et al., 2015; Moss & Grigos, 2012; Nijland, Maassen, van der Meulen, Gabreëls, et al., 2003; Terband et al., 2011). Given that speech motor control is task specific (e.g. Ruark & Moore, 1996), treatment that focuses on enhancing motor skill during non-speech tasks will not improve motor-skill for speech production.

SLTs have a professional duty to inform parents/caregivers about effective interventions and those that will be of no benefit so that they can make informed choices for their children. This can be especially important in areas such as CAS where non-evidence based commercially available apps or interventions are advertised to parents/caregivers. See RCSLT SSD Guidance for more information on non-speech oro-motor intervention.

Prognosis

The outcomes for children who have received intervention as recommended above is likely to be good (Murray, McCabe, Heard, et al., 2015; Strand, 2020). However, with such a heterogenic population, there is a range of possible outcomes e.g. no obvious remaining speech difficulties; residual speech and/or prosodic difficulties; other areas of difficulty becoming more dominant e.g. literacy difficulties. For a small number of children/adolescents the outcome is poor & they may require AAC/other support. Long term sequalae are similar to those for children with other subtypes of SSD. See RCSLT SSD Guidance (2024) for more information on the impact of SSD and phonological awareness.

Service delivery

General principles

See RCSLT SSD Guidance (2024) for information for service leads/lead SLTs to support provision of evidence based, high quality, effective and efficient speech and language therapy services for children with speech sound disorder (SSD). The principles for service delivery to children with CAS align with those for children with other SSD subtypes. However, there is evidence specific to CAS that should be followed for this group of children and may differ to that for other SSD subtypes. For all children with SSD, the intensity and spacing of intervention sessions is important for effectiveness and efficiency of service delivery. Evidence for CAS interventions is particularly compelling. Due to the rare nature of CAS and small number of children who present with CAS, it is possible to accommodate the increased demand within services with little disruption and high reward. An example of such an accommodation is in McFaul et al., (2022).

Supervision and mentoring

The speech and language therapy pathway for children with CAS should be led by a suitably qualified and experienced SLT. However, it is also necessary to support development of less experienced SLTs. It is possible that newly qualified SLTs may not have experience of CAS during their training, due to the low incidence of the condition; however, their academic learning will have included assessment and intervention for CAS as set out above.

If an appropriate level of supervision for experienced SLTs within their service is not available, they should be supported to access peer supervision through SSD CENs e.g. with protected time. The benefit to the service will be in increased quality assurance for the CAS therapy pathway. This is an area of rapidly evolving evidence and it is important to ensure that best practice continues to be implemented.

Supervision or mentoring should be offered to all SLTs working with children with SSD, including CAS in addition to access to CPD opportunities through SSD CENs and other providers. See RCSLT Supervision guidance (2018).

Agent of intervention

Children with CAS require direct input from an SLT for the intervention to be effective (ASHA, 2007; McCabe et al., 2024). There has been moderate success with delivery of DTTC intervention by trained and supervised teaching assistants (Lim et al., 2019). Parent delivered intervention is not supported by evidence and is not recommended (Thomas et al., 2017). However, additional support from parents and other adults for practice tasks in between sessions with the SLT may be helpful to achieve therapy goals more quickly. This may not be required if the intervention is being delivered with high intensity. Any additional activities will be provided and monitored by the SLT.

Group vs. individual

There is no theoretical basis for group therapy for children with CAS and subsequently, no research that evaluates group treatment for CAS. Such is the individual nature of the presentation of CAS and the high number of practice items required that group intervention is not recommended (McCabe et al., 2024). Individual therapy sessions delivered by an SLT are recommended for all children with CAS.

Treatment intensity (Dosage)

Treatment intensity will depend on the type of therapy implemented. SLTs should adhere to the recommendations for effective delivery of each intervention. Current evidence indicates that the greater the intensity the more effective and efficient the intervention (Edeal & Gildersleeve-Neumann, 2011). Intervention delivered four times per week in blocks of 12-16 sessions followed by a 4-6 week break from therapy is optimally effective (McCabe et al., 2024; Murray, McCabe, & Ballard, 2015). There is some evidence that as few as two sessions per week can also be effective (Namasivayam et al., 2015; 2023); however, the continued progress or generalisation seen in higher intensity delivery may not be present (Thomas et al., 2014).

Next steps

Timely and appropriate discharge should engage parents/caregivers and children in the decision-making process. Discharge should always be preceded by reassessment to ensure appropriate progress has been made. At discharge from speech and language therapy the procedure for re-referral should be explained, leaving this option open in case the child's speech and/or language needs change in the future. It is recommended that services should have transparent discharge criteria for children with CAS which supports clinical decision making and involves parents/caregivers and children or young people with CAS.

The following example of discharge criteria for CAS is from an NHS service that provides assessment and intervention for children with CAS in the form of a CAS pathway:

- No further therapy required
- Residual mild speech difficulty
- Speech errors resolved
- Client and/or parents satisfied with level of progress
- Limited parental/school involvement to support the programme on a regular basis, e.g. daily practice of specific activities
- Maximum potential achieved at the time of the decision
- Other therapy package is more appropriate to meet the child's need e.g. Augmentative Alternative Communication (AAC) – which would lead to the end of the CAS care pathway and care episode, but SLT intervention would continue as appropriate. It should be noted that individuals may return to a CAS pathway at future points in their development, as appropriate.

Commissioning services in the UK

There are a wide range of potential commissioners/contracting organisations and providers of services, and both these and the legislative and organisational contexts vary from country to country across the UK. The changes to the manner in which health services will be delivered and commissioned have a differing focus brought about by the advent of a changed set of political priorities in health, education and social care.

England

In England, there are 42 Integrated Care Systems (ICSs). Each ICS is made up of two bodies – the Integrated Care Board (ICB) and the Integrated Care Partnership (ICP). The ICB is responsible for planning and commissioning most NHS services in the area. Each ICB must produce a five-year

forward plan (updated annually) for how NHS services will be delivered to meet local needs. The ICP is a partnership between the NHS and local authorities within the ICS area. The ICP develops an integrated care strategy, which sets out how the wider health and care needs of the local population will be met. Services are delivered by provider collaboratives – partnerships between a number of different NHS providers across an ICS. This may also include local authority, social care, private, voluntary and independent sector providers.

Scotland

In Scotland, there are 14 Health Boards that receive health allocation budgets from the Scottish Government through a set of criteria based on population and need. SLTs are predominately employed by Health Boards or Health and Social Care Partnerships, however funding for their posts also come from arrangements that often take the form of service level agreements with any of the 32 Local Authorities responsible for setting education budgets.

Wales

In Wales, there are seven local health boards and 3 NHS trusts which receive their health allocation budget from the government. The local health boards are responsible for planning and delivering NHS services in their areas and NHS trusts look after public health, ambulance services as well as cancer and blood services. Uniquely, Wales has executive board members of therapies and health sciences. These roles have varied responsibilities but at a minimum professional accountability for therapy services.

Northern Ireland

In Northern Ireland, the roll out of the Integrated Care System NI is establishing a new commissioning framework. This will bring together a range of partners to collectively plan health and social care services based on population needs, with the aim of improving health and well-being and reducing health inequalities. Each of the five health and social care trust areas will have an Area Integrated Partnership Board (AIPB) with cross-sectoral membership including the voluntary and community sector, with full implementation due April 2024. Regional services are commissioned through the Strategic Planning and Performance Group based on the same principles of population need, value and will be outcomes-focussed.

Sources of support for families of children with SSD including CAS

The following online resources can be recommended to families. Some of these link to activities that are good for all children to support their speech and language development, if required, prior to assessment for CAS. They include information for bilingual children.

- BBC Tiny Happy People
- Better Health Start for Life. Learning to Talk 1-2 years
- Better Health Start for Life. Learning to Talk 2-3 years
- Better Health Start for Life. Learning to talk 3-5

These links are for organisations that offer information and support for families of children with SSD, including CAS. Some are not based in the UK and may refer to services that are not available here. Similarly, there will be services available in the UK that are not available in other countries.

- Afasic
- Speech and Language UK
- Dyspraxia Foundation
- Apraxia Kids

If parents or adults who have previously had a diagnosis of CAS are seeking speech and language therapy provision outside the NHS, please direct them to ASLTIP Find a Speech Therapist.

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Appendix 1: Single Case studies

Case 1 RS (a pseudonym)

Age at identification of concern	3 years 6 months – identified by Health Visitor and referred to Speech and Language Therapy
Gender	Female
Relevant medical history	No concerns
Other relevant case history factors	n/a
Any co-occurring communication difficulties e.g. Language delay, ASD	• 'Late talker' • Very sociable, but not being understood affecting friendships at pre-school • Increasing awareness of her difficulties
Any co-occurring primary difficulties	n/a
Nature of speech assessment/s undertaken at diagnosis	• Auditory Discrimination Screen • Nuffield Dyspraxia Programmes (NDP) Assessment • Diagnostic Evaluation of Articulation and Phonology (DEAP)
Diagnostic profile	• Childhood Apraxia of Speech diagnosis (CAS) given aged 4 years 2 months • Diagnosis given using service entry criteria to differentially diagnose • Restricted repertoire of consonants and vowels • Some difficulties with prosody • Inconsistent vowel errors • In continuous speech often difficult to 'hear' where one word finished and the next began • Assessment indicated her speech to be 60% inconsistent • Mostly unintelligible to both familiar and unfamiliar listeners
Who gave diagnosis	Speech and language therapist – Clinical Lead Speech Sound Disorders

Direct intervention provided - focus of therapy - amount of therapy - agent of therapy (including whether specialist etc)	• RS received a block (6 sessions) of Sound Fun (focusing on early Phonological Awareness skills) • Review assessment at 4 years 1 month indicated severe speech sound difficulties and features of Childhood Apraxia of Speech. RS was referred to Clinical Lead for differential diagnosis • At 4 years and 2 months, following CAS diagnosis, RS was seen in clinic, nursery, school or at home twice per week for 20-30 minutes by Specialist SLT following NDP approach as well as targeting whole words to ensure functional communication was successful. Therapy continued through school holiday time
Indirect intervention provided - focus - amount - agent - support provided by - amount of support given	• Daily home and school carryover of activities provided by SLT implemented daily by pre-school staff and home (parents) • This was monitored by using an individualised folder the child owned which included intervention worksheets and activities currently used and a 'casenote section' which is updated after each therapy session by the person delivering the therapy i.e. SLT, parents, school staff. This was used to track progress and the amount of additional work completed
Parental engagement	• Parent (mother) attended one of the speech and language therapy sessions per week • Parents carried out additional work provided by the SLT at home on a daily basis (5/7 days)
Pre-school engagement	Designated educational setting staff member carried over work on a daily basis at pre-school/school (usually 4/5 days) term time only
Outcomes - clinical re speech - clinical re communication - functional / social	• RS was initially very difficult to understand within context and completely unintelligible out of context. She worked with great enthusiasm and motivation to improve her speech and benefited from the structure the NDP provides. She continues to present with occasional errors but can self-correct if prompted to do so • RS's increased intelligibility has meant that her peer group now understand her and her confidence in the classroom has improved alongside her literacy skills • RS is now aged 5 years and 5 months (having received 15 months of twice weekly speech and language therapy), and she has been discharged

Case 2 MN (a pseudonym)

Age at identification	• MN had been known to his local speech and language therapy service since he was 3 years of age. Between 3- 5 years he received 3 courses of Parent – Child Interaction Therapy and attended one phonology group • He was seen at the specialist Paediatric Speech Clinic when he was 5, referred by his local SLT due to lack of progress. English was the only language spoken at home
Gender	Male
Relevant medical history	No relevant medical history
Other relevant case history factors	• No family history of speech and language or literacy difficulties. MN babbled at 18 months; he did not produce varied babble and first words were at 3 years. Two-word joining was late at 3;06. He was reported to have difficulties in blowing out his birthday candles • There were no reported gross motor difficulties
Co-occurring difficulties	• His receptive language was assessed on CELF – Pre-School. MN's scores were entirely within normal range for his age. His expressive language skills, screened on Renfrew Action Picture Test, showed grammatical delays • His school reported that MN enjoyed books and phonics and he was good at rhyme
Nature of assessment/s undertaken at diagnosis	NDP Assessment (2004), Oromotor Structure and Function, Conversational Speech, Prosody, DDK
Diagnostic label / summary of diagnostic profile given	MN was given a diagnosis of Childhood Apraxia of Speech. Assessment showed: • Restricted repertoire of consonants and vowels • Groping upon imitation, a wide range of consonants [t,d] were produced as [g]; he presented with a retracted pattern of articulation; [f,s,ʃ] were all produced as [h] or [ç] • Difficulties in DDK were noted in rate and accuracy. His DDK production was also inconsistent. "see saw" – [hihɔ, hiçɔ, çəhɔ] • Multiple errors within words were noted, even within CV words. For example, "pay" – [baɪ]; "fork"-[hɑ:]; "dinosaur" [gaɪçɒ] • In CVC words MN did not use any final consonants; his word structure was at CV level, and he used a few highly familiar VC words, such as "up" and "arm"

	• MN's performance showed a wide range of consonant and vowel errors in single word naming, multiple errors in familiar polysyllabic words, prolongations of vowels and also shortening vowel length in some words; frequent use of glottal stops within words, consonant sound omissions, prosodic issues affecting the rate and rhythm of speech. At sentence level there was increased frequency of sound omissions and substitutions. The words ran into each other; phrasing and rhythm sounded distorted. Vowel errors further reduced intelligibility. Example from spontaneous speech: "Who gave you that shark" – talking to the therapist about her toy bag – [həgælu: gæ: hʌʔ]; "a cup of tea" – imitation – [gʌʔʌʔgi] • MN's mother reported that she was able to understand about 50% of his message out of context and this had started to upset him at home
Who gave diagnosis	Consultant SLT (experienced in CAS and SSD)
Direct intervention	• MN received 18 sessions of direct weekly speech and language therapy delivered by the Consultant SLT • The targets of therapy included expansion of vowel and consonant inventories, correct production of vowels in CV and VC syllables in imitation and naming. Correct production of consonants at the front of the mouth, starting with [p,b,m,n,l,w] in CV and VC syllables. MN worked on phonetic placement for [t,d] and later [f,v] were introduced at CV and VC levels in imitation and naming. Practice included sequencing exercises to build accuracy and consistency. Once these target sounds, and syllables became accurate at 90% level MN was encouraged to produce CVCV words containing these sounds. Particular attention was paid to smooth joining of syllables and reducing the use of glottal stops word medially • Phonetic placement for [s,z] was taught and practised at CV and VC levels • In the remaining 9 sessions of therapy MN practised joining final consonants to the onset of the word starting with consonants which he found easy; initially continuants were used. For example, moo +n – moon; far+m – farm; war+ m – warm. Gradually, other consonants which had been targeted in therapy were included in CVC target words as well • MN was encouraged to attempt short phrases with the targeted word structures and the new sounds which he had learned in therapy • As bringing his articulation forward had been so difficult for MN, it was decided that new consonants should not be added to therapy targets, but further practice should be carried out to consolidate the use of sounds learned in the word structures including 3-syllable words and [s] clusters • At phrase level and at word level use of glottal stops, vowel length and smooth joining of syllables with appropriate stress were monitored

	• Speech and language therapy aimed to build accurate motor programmes for the individual sounds and targeted words for MN and worked on his motor programming skills by encouraging mass practice and distributed practice of targeted words • MN was discharged to his community SLT therapy service with the suggestions that he should continue to receive a course of 10 further sessions of weekly therapy to work on the consonants which were not included in this course of therapy and to consolidate his production at sentence level • Speech and language therapy was not possible locally due to staff shortage • After a short break MN was offered teletherapy at the Paediatric Speech Clinic and he had a course of 10 sessions • This work was on teaching [ʃ ʧ ʤ], consolidating the consonant cluster words and sentence level speech production. Morpho phonemic targets were included in therapy • Parents and MN's school teacher commented that his conversations speech had become much more intelligible and sounded "more natural"
Indirect intervention	MN's mother practised the therapy targets daily. His classroom teaching assistant (TA) was given time to observe the teletherapy sessions
Parental engagement	MN's mother was highly motivated to help him and practised with him daily
School engagement	• The school was pleased with MN's participation and performance in class • The classroom TA was allowed time to observe the teletherapy sessions and practised with MN on 2 days a week
Outcomes	• MN's speech demonstrated a very encouraging improvement at the end of this course of therapy. His accuracy at CV, CVCV, CVC levels in the Nuffield Assessment were 100% and for multisyllabic words he scored 95% with Consonant Clusters and Sentences at 90% • Using The Intelligibility in Context Scale his parents reported that they were always able to understand his speech and teachers and extended family understood him usually. MN's frustration levels were reported to be much lower than they had been at the start of this course of therapy

Case 3 KL (a pseudonym)

Age at identification	First seen by SLT at 3 years in locality. Referred to specialist centre at 9 years
Gender	Male
Relevant medical history	Intermittent nocturnal enuresis during term time, since starting school - suspected to be due to anxiety
Other relevant case history factors	• Late acquisition of early speech and language milestones: babbling at 12 months/ 12 weeks, first words at 16 months/12 weeks, word joining at 2.6 yr • Strong family history – KL's father had SLT as a child and still has some language and memory difficulties; KL's younger sibling, aged 6 years, receives speech and language therapy • Fine motor co-ordination difficulties (seen by Occupational Therapist) and constantly moving
Co-occurring difficulties	• Some persisting grammatical immaturities • Some pragmatic difficulties • Some literacy difficulties e.g. affecting hand writing and spelling
Nature of assessment/s undertaken at diagnosis	• NDP assessment • Oro-motor examination • Imitation of single consonants and vowels • Connected speech assessment
Diagnostic label / summary of diagnostic profile given	• Severe Speech disorder with features of both Oro-motor Dyspraxia (OMD) and CAS • Restricted repertoire of consonants and vowels • Significant number of vowel and consonant errors, combinations of C+V errors in single words; prosodic issues affecting rate and rhythm in particular • Speech unintelligible much of the time at 9 years old
Who gave diagnosis	Experienced specialist SLT (speech impairment/dyspraxia) and consultant paediatrician

Direct intervention	• Weekly speech and language therapy in his locality for 6m aged 3.6 years. When KL started school, speech and language therapy input was 1 termly visit from SLT who set a programme for TA to deliver • Since referral to specialist centre at 9 years, KL has received 21 sessions SLT on a 2-3 weekly basis in term time over a 16 month period NDP therapy approach has been followed: • Single sounds: expansion of single consonant and vowel inventories (very restricted ranges at outset of intervention; effortful, groping postures seen) • Expansion of single consonant and vowel repertoires (all diphthong vowels and /j, ʃ, ʧ, ʤ, ɹ, r/) • Establishing newly acquired sounds into all positions in words • Consolidating other sounds in singleton and clusters within words • Maintaining accurate production in connected speech • Motor programming/drill activities • Strategies for clear speech (pacing, sounding out final sounds in 'small words', using intonation etc)
Indirect intervention	• Speech and language therapy sessions supported at home, with parents practising targets as often as possible • Daily practice of speech targets in school with TA • TA attends speech and language therapy sessions intermittently at specialist centre
Parental engagement	Very motivated to engage with the therapeutic process; KL's Father particularly empathises. Have to travel a long distance to attend specialist centre
School engagement	Education Health and Care Plan in place and receives 17 ½ hours of TA support per week; the speech and language advisory teacher visits
Outcomes	• KL has become increasingly intelligible over the intervention period • However, communication breakdown can still occur • KL has expanded his range of consonant and vowel sounds in isolation and is establishing them in simple and complex words • KL is thinking more and more about his strategies for clear speech – including more awareness of the listener's perspective • KL is pleased with his progress and aware that he is improving; motivated as he approaches secondary school transfer

Appendix 2: Service case studies

1. NHS Community Speech and Language Service

Current service delivery model:

In January 2009, a specialist service supporting children with CAS was created offering twice weekly direct ongoing therapy to each child that meets the criteria, detailed below:

Entry criteria:

Specialist speech assessment is carried out by Highly Specialist SLT using formal and informal assessments for differential diagnosis to be reached. Diagnosis of CAS given.

Therapy Package:

Twice weekly therapy is offered at the child's school or nursery/home/clinic with reviews taking place every 12 weeks to ensure intervention is tailored to the individual child's speech, language and communication needs. Therapy is delivered by a Highly Specialist SLT and carried over on a daily basis by school/nursery staff and parents.

Exit criteria:

a) No further therapy required (mild speech difficulty; speech errors resolved; client/parents satisfied with level of progress);
b) Not ready for direct speech work (limited intent) c) Other therapy package is more appropriate to meet the child's need e.g. Augmentative Alternative Communication (AAC).

Drivers behind service delivery model

Team managers identified that the needs of the children with the CAS symptom cluster were not being met effectively through the clinic therapy package offered in our area. Children with suspected or confirmed CAS features were seen for speech and language therapy in their local community clinics, accessing a therapy package of six-weekly blocks (one session per week). Therapy blocks were sporadic as the waiting times in between blocks depended on waiting lists at the time. Children's progress was slow and they often remained in this cycle of having blocks for a significant amount of time.

Also, special school and nursery placements, offered locally, significantly decreased and admission criteria changed which resulted in children with CAS attending mainstream settings which could not effectively meet their needs without direct SLT intervention.

Service design process

Following discussions and ratification with the Senior Management Team and Commissioners,

the CAS service was set up within 2 months. The SLTs appointed used this time to perform the following searches: a) a literature search to collate available information and examples of good practice in the field of CAS to inform service delivery model; b) a caseload review to identify caseload size and level of need within the department & c) searches of literature on CAS definition and diagnosis and therapeutic approaches.

Clinical Effectiveness/Outcomes

Clinical effectiveness is measured using outcomes, currently MyPlans, which are evaluated every 12 weeks, highlighting positive results. Data collated between January 2009 and October 2010 indicated that out of 24 cases who were seen over that period of time (age range 3;5 yrs -13;9 yrs) 10 were discharged due to exit criteria (a) discussed above.

Service user feedback including parental and school/nursery's reports, are collected through post therapy questionnaires and yearly focus groups. Feedback continues to provide strong support for this service model as respondents give clear preferences as to therapy being delivered in their day-to-day environments (school/nursery/home). They also identify additional benefits such as active engagement in the therapy process playing a key role in positive outcomes.

Challenges & Future Direction

The service is hindered by the geography of the district and the distances needed to be travelled in order to see the children in schools/nursery/home are vast.

2. Speech Sound Disorders Team at The Royal National Ear Nose and Throat and Eastman Dental Hospitals UCLH

Current service delivery model

The Paediatric Speech Clinic (previously known as the Nuffield Speech Clinic) at Royal National Ear Nose and Throat and Eastman Dental Hospitals is the only national specialist NHS service specifically specialising in children presenting with Childhood Apraxia of Speech.

The Speech Sound Disorders Team provides a tertiary level second opinion service for the assessment and treatment of complex speech sound disorders. The team has a particular expertise in the assessment, diagnosis, and treatment of Childhood Apraxia of Speech.
The primary aim of the service is to provide specialist assessments and state the child's speech and language therapy needs in reports.

Referrals are made by local speech and language therapists (SLTs) and doctors.
The service provides diagnostic assessment. Children are assessed in a joint clinic by an expert speech and language therapist and a consultant in audiovestibular medicine. Following assessment, verbal recommendations are made, and written reports are distributed to the referrer, parents, and local practitioners (with parental permission). Feedback and management/intervention advice is provided by the expert SLT to the local SLT in the report. We liaise with local SLT colleagues by telephone and / or email after the clinic.

In addition to an assessment service, we provide time limited specialist therapy, with the aim of supporting local services in meeting children's needs. The focus of therapy is often to explore effective intervention strategies and overcome particular obstacles, for individual children.

Therapy approaches include Nuffield Dyspraxia Programme (NDP3), Dynamic Temporal and Tactile Cueing (DTTC), Rapid Syllable Transition Treatment (ReST), Ultrasound and Electropalatography (EPG) for children over 8 years, with persisting articulation difficulties. Therapy sessions may be offered on a weekly or 2-weekly basis, or as an intensive block during a week within the school holidays. Local therapists and SLT assistants/teaching assistants are encouraged to attend sessions where possible.

We also provide support, management advice, and discussion for SLTs working with children with Childhood Apraxia of Speech. Colleagues can contact the department (uclh.paediatricslt@nhs.net) and request a call back.

Drivers behind service delivery model

- SLTs may be unable to access specialist support for challenging cases in their locality, and therefore need access to a national centre.

- Parents may require a second opinion, on the nature of their child's difficulty and/or advice on management, and quantity of therapy independent of their local provision.
- Given the low incidence of Childhood Apraxia of Speech, this national NHS centre ensures the possibility of access to specialist services for all.

Clinical Effectiveness/Outcomes

The aim of the service is to improve speech and quality of life outcomes for children with severe speech disorder, and especially those presenting with Childhood Apraxia of Speech. The effectiveness of the assessment and therapy service is regularly evaluated through parent questionnaires. Following assessment, parents report increased understanding of their child's needs and success in accessing appropriate local services to support their child. Following intervention, parents report high levels of satisfaction and positive therapy outcomes. Pre and post intervention assessment results, based on the Nuffield Dyspraxia Programme Assessment (NDPA) and other formal/informal measures, are used to measure clinical effectiveness.

The Royal College of Speech and Language Therapists (RCSLT) is the professional body for speech and language therapists in the UK. As well as providing leadership and setting professional standards, the RCSLT facilitates and promotes research into the field of speech and language therapy, promotes better education and training of speech and language therapists, and provides its members and the public with information about speech and language therapy.

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