

## **Supplemental Material S4. Research protocol.**

**Title of the study:** Prospective, multicenter study on the effectiveness of outpatient stuttering treatment with the stuttering modification therapy KIDS (PMS KIDS)

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Note: This document details the trial protocol in English and follows the WHO recommendations concerning part 1 (<https://www.who.int/groups/research-ethics-review-committee/recommended-format-for-a-research-protocol/>). The information is based on the funding application (2017/05/23) and the ethical approval of the study (2018/10/11).

## Contents

Research protocol: part 1 .....	4
Project summary .....	4
General information .....	4
Rationale & background information .....	5
Study goals and objectives .....	6
Study design .....	6
Research population and sampling frame.....	7
Methodology .....	8
Randomization and blinding .....	8
Procedures.....	8
Outcome measures .....	9
Intervention .....	9
Safety considerations.....	11
Risk-benefit analysis .....	12
Follow-up and termination.....	12
Data management and statistical analysis .....	12
Data management.....	12
Sample size calculation .....	13
Statistical Analyses .....	13
Quality assurance .....	13
Expected outcomes of the study .....	14
Dissemination of results and publication policy .....	14
Duration of the project.....	15
Problems anticipated .....	16
Project management.....	16
Ethics.....	17
Informed consent process .....	17
Other ethical considerations .....	17
Informed consents.....	17

References .....19

## Research protocol: part 1

### Project summary

The German guideline for fluency disorders (DGPS, 2016) showed missing evidence regarding internationally known and frequently used stuttering treatments. The aim of this nationwide, multicentre clinical study is to examine the effectiveness of a German best practice treatment for stuttering elementary children (*KIDS*, Sandrieser & Schneider, 2015) under every day conditions.

According to the study's design as a prospective, randomized interventional study, 52 stuttering children will be evaluated for 12 months of individual treatment. Half of the children starts their treatment after 3 months, in order to compare the changes after 3 months of treatment to 3 months without treatment. The primary outcome will be the *OASES-S* (Yaruss, Coleman & Quesal, 2016), a self-report measure based on the ICF that gives insight in the impact of stuttering in multiple life situations. It is expected that the largest treatment changes after 3 months will occur in the *OASES-S*. Secondary outcome measures include the *Stuttering Severity Instrument (SSI-4)*, Riley, 2009) and severity ratings of the parents. Treatment changes after 3, 6 and 12 months will be statistically analysed using a two-way repeated measures ANOVA for primary and secondary variables.

### General information

- Prospective, multicentre study on the effectiveness of out-patient stuttering treatment with the stuttering modification therapy *KIDS*, registered in the German Clinical Trials Register (identifying number: DRKS00015851, date of registration: 2018/11/07)
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## Rationale & background information

Stuttering is a fluency disorder in which the person who stutters knows exactly what her or she wants to say, but is unable to do so fluently. In severe cases, stuttering can prevent communication completely and typically increases in severity as time progresses. In particular, affective, cognitive and behavioural reactions (secondary symptoms) to the primary symptoms can have a negative impact on school performance, limit later career opportunities and lead to social isolation (Natke & Alpermann, 2010).

According to the current health care situation in Germany, those affected by stuttering who are insured in statutory health insurance are entitled to stuttering therapy in accordance with the guidelines for remedies (2017). For people who stutter, the catalogue of remedies in its current version from May 19th, 2016 assumes that 50 therapy sessions of 30-60 minutes each, at least once a week, usually lead to appropriate medical and economic care. A current, nationwide survey of 70 speech therapists confirmed that the current standard of care for stuttering clients in outpatient speech therapy facilities corresponds to the catalogue of remedies, most often providing extensive, individual therapies with 1-2 weekly sessions of 45 minutes each (Kohmäscher, 2017). This survey also showed that, in Germany, the behavioural therapeutic approach of stuttering modification is most widely used in all age groups.

In the course of the development of the current AWMF (working group of scientific medical societies) guideline for fluency disorders (DGPP, 2016), a systematic review regarding the effectiveness of stuttering treatment was generated. The authors concluded that, internationally, the effectiveness of only a few stuttering therapy methods has been proven based on methodologically high-quality studies: existing evidence only supports the

recommendation of the Lidcombe program for stuttering preschool children and fluency shaping therapies for stuttering adolescents and adults.

The guideline revealed only weak and incomplete evidence for the approach of stuttering modification, which is widely used in Germany (Blomgren, Roy, Callister & Merrill, 2005; Laiho & Klippi, 2007; Natke, Alpermann, Heil, Kuckenberg & Zückner, 2010). Consequently, the guideline concluded that the use of stuttering modification as treatment approach "should be considered", but did not clearly recommend its use (DGPP, 2016, p. 120). The lack of evidence for the age group of primary school children is even clearer: "For 6 to 12 year olds there is no solid evidence for any treatment." (DGPP, 2016, p. 12).

The lack of evidence for stutter modification therapies that are predominantly applied in Germany shows an urgent need to examine the effectiveness of current stuttering modification therapies in Germany in order to ensure the quality of care for people who stutter. The guidelines emphasize this necessity: "From a therapeutic and health care policy perspective, research into the effectiveness and efficiency of therapy methods under everyday conditions, taking into account long-term results, appears to be a priority" (DGPP, 2016, p. 162). In this context, everyday conditions refer to outpatient, extensive speech therapy in speech practices or other facilities (Kohmäscher, 2017). Since there is almost no evidence concerning the effectiveness of stuttering modification or any other therapy method in primary school children, this age group is chosen for this effectiveness study.

## Study goals and objectives

This study investigates the short and medium-term effectiveness of outpatient stuttering therapies, which correspond to the typical standard care according to the catalogue of remedies. Thus, we intend to close the evidence gap regarding the effectiveness of stuttering therapy in primary school children and to make statements about the effectiveness of care under everyday conditions in Germany.

Main research question:

How does outpatient, extensive stuttering therapy according to the *KIDS* modification approach affect the primary and secondary symptoms of 7-11-year old children who stutter after 3, 6 and 12 months?

Primary hypothesis:

- a. After 3 months of therapy, the impairments caused by stuttering, measured using the *OASES-S*, are significantly lower in the therapy group than in the waiting control group.

Secondary hypotheses:

- b. After 6 months of therapy, scores in the *OASES-S* show significant improvements compared to the start of therapy.
- c. After 12 months of therapy, scores of the *OASES-S* show significant improvements compared to the start of therapy.
- d. After 6 months of therapy, scores in the *SSI-4* are significantly reduced compared to the start of therapy.
- e. After 12 months of therapy, scores in the *SSI-4* are significantly reduced compared to the start of therapy.
- f. After 3, 6 and 12 months of therapy, the parents' subjective ratings of stuttering severity show a numerically, monotonically decreasing, trend across the time points.

## Study design

In this study, the effectiveness of the therapy method *children are allowed to stutter* (*KIDS*, Sandrieser & Schneider, 2015), a *best practice* method in Germany, will be examined. The aim is to achieve the highest possible level of evidence under everyday conditions and therefore a prospective randomized clinical intervention study with a delayed-treatment waiting control group was chosen as study design (Figure 2). The entire observation period per participant includes 12 months of therapy time (T3 or T4) plus 3 months initial waiting time for the waiting control group (=15 months). Due to the heterogeneity of treatment courses in individualized treatment with *KIDS* and the increasing chronicity of stuttering at this age, there

is no fixed therapy endpoint. The selected observation period still allows meaningful statements, since - after deducting vacation and sickness periods - around 50 therapy sessions can be completed within a year, which corresponds to the standard care in the current catalogue of remedies (50 therapy sessions, frequency: 1-2 times a week).

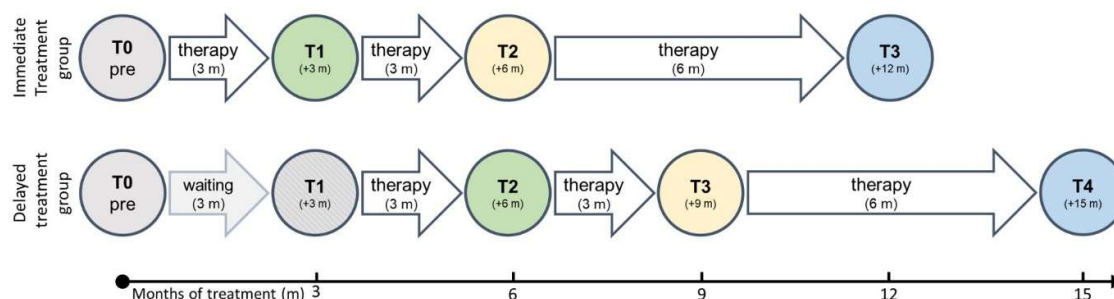


Figure 1: Overview of measurement times in both therapy groups

Due to the delayed start of therapy in the waiting control group, differences *between* the groups at T1 and *within* the groups after 3 months of therapy (T0 to T1 in the immediate-treatment group; T1 to T2 in the delayed-treatment group) can be analysed. Based on the results of stuttering therapy in preschool age, the most significant changes are expected after 3 months of therapy (DGPP, 2016). Irrespective of age and treatment method, the guidelines also require that after 3 months a benefit of the therapy should become apparent, which is why this point in time represented the basis for the sample calculation and was also used as a basis for the formulation of the primary hypothesis.

Further therapy changes *within* the groups are measured after 6 months (T2 in the immediate-treatment group or T3 in the delayed-treatment group) and 12 months of therapy (T3 in the immediate-treatment group and T4 in the delayed-treatment group). A longer-term comparison *between* the groups is unethical. For these reasons, comparable studies in preschool age are often limited to a short observation period of 3-4 months. Only one study with a control group without therapy examined therapy effects over a period of 9 months (Jones et al., 2005), but in this study therapeutic interventions were necessary for 28% of the children in the control group.

Urgently needed longer-term measurements up to 1 year after the end of therapy cannot be implemented within the funding period due to the unpredictability of treatment duration, but are kept in mind for follow-up projects.

#### Research population and sampling frame

Approximately 1% of a given society is affected by stuttering (Natke & Alpermann, 2010). Due to high recovery rates near onset of stuttering the prevalence rates are higher in children than adults who stutter. According to an Australian (Craig & Tran, 2005) and German (Neumann, Euler & Schneider, 2014) study it can be cautiously estimated that around 1.4% of school aged children stutter. In Germany, approximately 3,452,000 children go to primary school, possibly resulting in roughly 40,000 children who stutter in this age group.

Other controlled intervention studies with preschool children who stutter have an average sample size of 41 subjects with a drop-out rate of 21-60%. Based on the current survey by Kohmäscher (2017), 49 therapists would take part in the study and estimate to provide 77 participants in total (required sample size according to power calculation:  $n = 52$ , see below). While a low drop-out rate of 20% would result in 61 children, a more realistic drop-out rate of 30% would require 75 children. In light of the long recruitment period (17 months) and the long follow-up period (12 months), we aim to include 75 children, assuming that this will safely result in a final sample size of 52 children who stutter.

The inclusion criteria correspond to the usual criteria of comparable studies and are deliberately kept liberal: 1) age at the start of the study between 7;0 and 11;0 years (primary school grades 1-4), 2) at least mild to moderate impairment in the OASES-S in the initial diagnosis, 3) sufficient German language skills of the child and the parents to be able to

participate in the therapy (checked by research team and clinician). Other neurological, linguistic, emotional or behavioural impairments that prevent the implementation of stuttering therapy according to KIDS are considered exclusion criteria.

Based on the survey (Kohmäscher, 2017) we believe that within 17 months, on average, two children who stutter will ask for treatment at a given speech centre. Thus, assuming that each clinician will provide two participating children for the study we aim to include 32 clinicians from nationwide speech centres.

## Methodology

### *Randomization and blinding*

In order to allocate participating children to the two treatment arms (immediate-treatment vs. delayed-treatment), we use block randomization, stratified by age (above/below the expected median of the sample) and sex (boy/girl, based on 4:1 prevalence rates). The randomization takes place after we received written informed consent of the parents and child to participate in the study. It is carried out by the coordinator of the study and managed centrally across and for all participating institutions.

The result is only transmitted to the treating clinician and the parents, as it is impossible to blind them regarding the treatment arm their child belongs to. For ethical reasons, however, we encourage clinicians to start treatment of the children in the waiting control group as quickly as possible after the 3-month waiting period. The two research associates who collect each 50% of the data on site will not be informed about the results of randomization.

The same research associates are also blinded during data analyses as each will analyse data that were obtained by the other associate. Besides, speech samples will be recoded so that the assessment point to which a speech sample belongs to remains unclear.

### *Procedures*

Whenever a stuttering child of primary school age registers in a participating speech centre, the clinician uses a standardized screening form to assess whether the child could be a candidate for the study. During this initial phone call, the clinician provides information about the study, including the randomization of the groups. If the parents agree, the clinician asks for permission to be contacted by the project coordinator or leader. In a phone call within 1-2 days, this research team member explains the conditions for participating in the study in detail and answers questions. As soon as the parents have given their written informed consent, the research coordinator makes an appointment for the first data collection (T1) which takes place in the speech centre of the treating clinician.

For each assessment point (T0 to T4), the parents and the research associates collect data on site. With the consent to participate in the study, the parents also agree to record two conversations of their child at each assessment point in the home environment; the recording equipment for this purpose will be made available to them. One speech situation should be a conversation between parent and child at home, another speech situation should be a conversation between the child and an unrelated adult somewhere else. The minimum length of each conversation is 10 minutes. To ensure a high-quality speech sample, the parents receive a leaflet with relevant information (e.g. regarding a high proportion of speaking-time by the child). The audio recordings are either handed over to the research associate or uploaded to a special website.

Furthermore, at each assessment occasion a given research associate conducts a conversation with each child on standardized topics. This interview will be videotaped and should meet the above mentioned criteria in terms of length. Children whose reading abilities are sufficient are also asked to read aloud a text appropriate to their reading age. Both speech samples form the basis for later evaluation using the *SSI-4*. After the interview and reading, the questionnaire *OASES-S* is filled out. Depending on the age of the child, the items are read out by the research associate or the child reads silently. Finally, parents are asked to provide current severity of their child's stuttering and their satisfaction with communication on a 10-point scale. The total duration of each data collection should not exceed one hour.



### Outcome measures

The selected outcome measures are based on the recommendations of the German guideline on fluency disorders and are intended to enable comparisons with other clinical studies. They depict the changes to be expected after stuttering modification therapy as comprehensively as possible and at the same time meet the requirements for economical, child-friendly data collection:

1. Overall Assessment of the Speaker's Experience with Stuttering - Scholars (OASES-S; Euler, Kohmäscher, Cook, Metten & Miele, 2016)  
This standardized questionnaire, developed in the USA, uses 60 items to determine the impact of stuttering on the lives of school-aged children who stutter between 7-12 years (Yaruss et al., 2016). The OASES-S consists of 4 subscales, namely *General Information*, *Reactions to Stuttering*, *Communication in Daily Situations* and *Quality of Life*. All subscales of the OASES-S are based on the *International Classification of Functioning* (WHO, 2010). The German version of the OASES-S is available since 2016.
2. Stuttering Severity Instrument 4 (SSI-4; Riley, 2009)  
The SSI-4 is an internationally accepted, standardized test to determine the severity of stuttering for children, adolescents and adults. Three dimensions of stuttering – stuttering frequency (percentage of stuttered syllables), duration (mean duration of the three longest stuttering events) and physical concomitants (using four rating scales) are evaluated on the basis of a spontaneous speech sample and, if possible, a reading sample.  
Taking into account the variability of stuttering symptoms, the frequency and duration of stuttering is also determined for the two audio samples collected by the parents.  
Stuttering frequency is analysed by using a counting device (LogoHSCan) while playing the audio or video sample. To determine the duration of the 3 longest stuttering events, the software *Praat* (Version 6.0.25) is used.
3. Subjective Ratings of the parents  
Scale-based ratings are used to assess the subjective success of the therapy as perceived by the parents. The severity scales from 0 (no stuttering) to 10 (extremely severe stuttering), which have been used successfully in Lidcombe therapy, are presented to the parents and asked for a subjective assessment of the current severity of stuttering. The same scale is used for parents to judge their current satisfaction with their child's communication.

### Intervention

Prior to the start of the study, the authors of *KIDS* will develop a manual on the therapeutic procedures based on an existing publication on the KIDS approach (Sandrieser & Schneider, 2015). Generally, *KIDS* aims to reduce secondary symptoms and psychological reactions to stuttering so that relaxed, effortless stuttering can be established. It is assumed that this makes it easier for children to achieve remission.

*KIDS* consists of two similar variants for pre-school children (mini-*KIDS*) and for primary school children (school-*KIDS*). School-*KIDS*, on which this study is based, is a stuttering modification therapy for 7-12 year old children who stutter. The main objectives are:

1. the reduction of socially disapproved secondary behaviour and negative psychological reactions to stuttering;
2. the improvement of quality of life and resilience through communicative competence, and a self-image as a competent and self-efficient speaker with the willingness and ability to help oneself;
3. the ability to provide information about stuttering;
4. to the extent possible, the creation of a supportive environment in which parents can act as disseminators to inform other caregivers  
(Schneider, Sandrieser & Kohmaescher, in preparation).

Similar to stuttering modification treatment in adults following the phases of Van Riper, *KIDS* consists of several treatment phases that may, but do not need to, appear in chronological order:

1) Information and contract phase: At the beginning of the therapy, the parents and the child receive detailed information about the content and goals of *KIDS* and conclude a joint treatment contract that sets out the individual goals, mutual rights and obligations of all those involved. During the course of treatment, agreement on the contract is re-established or parts of the contract are modified as needed. Providing information on different aspects of stuttering and treatment methods is continued during the course of treatment (Treatment goals 3 and 4).  
2) Desensitization: The therapy then begins with the desensitization phase, in which an increasing acceptance of one's own stuttering is to be achieved. To this end, the child receives child-friendly information about their stuttering, begins to talk about their feelings and thoughts about stuttering and learns pseudo-stuttering. In pseudo-stuttering, the child intentionally imitates stuttering events while gaining control over stuttering and gradually becoming less sensitive to their own stuttering events. Pseudo-stuttering is used in-vivo, meaning in many real-life situations outside of the therapy room, for a transfer into everyday life (treatment goals 1 and 2).

3) Identification: This phase is strongly associated and may overlap with the desensitization phase as the child learns to analyse the core symptoms, associated behaviours, avoidance and psychological reactions in a neutral, non-judgmental way. This serves to desensitize the child towards his or her symptoms (treatment goal 1) and to prepare the child for the modification phase.

4) Modification: In this phase the core symptoms of stuttering are addressed as the child is taught techniques to regain control of his or her speech in stuttering events. In *KIDS* two modification techniques can be trained: at first, prolongation (a variant of the preparatory set of Van Riper) for the prevention of a symptom and second, the pullout, a technique of Van Riper to change the physical tension during a symptom and to ease out of this symptom. The use of these techniques is practiced extensively within therapy, but also outside in order to integrate them into everyday life (treatment goal 2).

5) Generalization: This phase starts early in the treatment process as the child learns to transfer his/her skills into many areas of every day life (treatment goal 2). Therefore in-vivo exercises are central for generalization. In addition, generalization refers to the preparation of the child for the end of therapy and aims to enhance the child's competency to manage stuttering and related fears on its own. At the end of therapy, regular treatment sessions are replaced by refresher sessions in between longer periods of self-management (follow-up).

While information and contract, identification, desensitization and generalization are mandatory phases in *KIDS*, the modification phase may be omitted if stuttering symptoms are rare, short and not associated with struggle behaviours. In addition, *individualized, variable treatment planning* is central in this intervention. This means, that phases may overlap, be shortened, intensified or postponed as needed by the child. To prevent arbitrariness, the manual lists for each phase the *premises*, e.g. establishment of a treatment contract before desensitization, and the *goals* of the specific phase, e.g. avoidance behaviour is markedly reduced after the desensitization phase. The clinicians were asked to check on the achievement of these goals in order to decide whether to transition into a new phase or add elements of another phase (e.g. elements of identification and desensitization). To support this clinical reasoning, the manual describes for each phase typical phenomena or problems and suggests "trouble-shooting", e.g. how to react if parents refuse pseudo-stuttering. Short case descriptions illustrate phenomena and therapeutic approaches.

Individual treatment sessions are not prescribed in the manual, however, a checklist is provided for each phase in which basic activities for this phase are listed and can be checked as well as commented. Furthermore, procedures for a series of sessions are recommended in the manual, e.g. consecutive steps for the acquisition of the pullout. The manual is accompanied by a collection of exercises, illustrations, and documentation and education sheets for the child and caregivers (200 PDF-pages), which may (but not must) be used by the clinicians.

Criteria for the end of therapy are: 1) the child stutters mildly (symptoms last less than ½ second and are free from struggle) or not at all, 2) the child has a positive self-efficacy in coping with stuttering symptoms, difficult speech situations and negative listener reactions related to stuttering and 3) adequate reactions in the environment towards stuttering prevail. The regular

"contracting" sessions with the parents and the child (every 4-6 weeks) serve to determine *together* whether these criteria are achieved and if the therapy is to be ended. The end of therapy is always accompanied by the follow-up phase in order to make sure that the acquired skills and psychological reactions are stable.

The authors recommend a 45-minute long therapy session at least once a week for the outpatient use of *KIDS*. This intensity is specified for the study within the first 3 months in order to ensure comparability. After this period, the clinicians are free to choose a frequency of 1 or 2 weekly therapy sessions.

Treatment fidelity of the clinicians is ensured by a one-day initial training and subsequent supervision appointments at intervals of 3 months. In addition, the clinicians can seek advice by telephone. Apart from that, clinicians are free to provide the *KIDS* therapy according to their own individual clinical reasoning as long as their approach does not contradict the manual. The clinicians document the number of sessions and the contents of each therapy session (e.g. desensitization against listener reactions) in the standardized forms provided and forward them to the scientific staff for quality assurance and evaluation.

## **Safety considerations**

Stuttering children represent a vulnerable group due to their minor age and the impairment of the flow of speech, which must be particularly protected in the context of the study. Therefore, the parents will only be contacted by the research team if they have given their explicit consent to the treating clinician.

Data collection at several assessment points includes the collection of a spontaneous speech sample by scientific staff and completion of the questionnaire *OASES-S* with the children. Above all, a conversation with an unknown adult represents a higher than normal psychological everyday stress for children, which is why the presence of the parents is left up to the child, the conversation is embedded in a pleasant game interaction and takes place in the premises of the treating speech therapists. If the child refuses to speak, the speech sample will be waived and only the speech samples collected by the parents will be used. The *OASES-S* items on quality of life and accompanying reactions to stuttering symptoms are of a personal nature and are carried out after the interview and an increasing familiarity with the examiner. If children refuse to answer the questionnaire in whole or in part, the *OASES-S* may also be completed with the treating speech therapist. The length of time for the assessments is estimated generously at one hour and offers sufficient space to address personal needs. The cognitive demands can be assessed as low.

With the *KIDS* therapy approach, the intervention represents a standard treatment that is also carried out without participating in the study; in this respect, there is no study-related risk for the children involved.

The study design requires randomizing the children into a therapy group with immediate start of therapy and one with a delay of 3 months. During the three-month waiting period for therapy, there is a risk for the children in the waiting control group that the stuttering symptoms will worsen and/or that the waiting period will be perceived as disadvantageous. In these cases, parents can seek advice from their therapist and arrange for them to drop out of the study and start therapy immediately. The probability of a prognostically relevant worsening of the stuttering symptoms in the 3 months is classified as low, since stuttering in this age group has lasted for at least a year in almost all cases and a certain chronification has already started. In addition, the chance of remission at this age is significantly lower (DGPP, 2016) and a quick start of therapy is less important. According to a study by Jones, Onslow, Harrison and Packman (2000), a short waiting time does not have a negative effect on the subsequent duration of therapy.

Participating therapists could feel additional pressure from participating in the study to bring about the desired therapy effects as quickly and to the greatest possible extent. Before the start of the study, they will also be informed in detail that the individual effects of individual institutions will not be published, that the therapists' anonymity will be guaranteed and that they can withdraw from the study at any time without disadvantages.

### ***Risk-benefit analysis***

In the benefit-risk assessment, it is assumed that the benefits of participating in a study clearly outweigh the risks and burdens. Particularly noteworthy is the high quality of therapy, which can be expected from the training of the clinicians, the use of a manual and regular supervision. Furthermore, the study is being carried out under everyday conditions, so that there are no treatment specifics due to the study.

The risks and burdens relate to the additional assessments and the waiting time for half of the subjects. For the assessments, the loads were minimized and alternatives planned. With regard to the waiting time, priority is given to the indication for therapy, in addition to emphasizing the voluntary nature of participation: as soon as an immediate start of therapy appears indicated by the parents, the clinicians or the project staff, the child is out of the question for participating in the study. The following must also be taken into account: according to the survey by Kohmäscher (2017), a waiting time of 2 weeks to 6 months is common in speech centres and parents have to be prepared for a waiting time regardless of their participation in the study. The clinicians give priority to the children in the waiting control group for appointments so that even if they are assigned to the waiting control group, the waiting time is limited regardless of their place on the waiting list.

### **Follow-up and termination**

Each child will be assessed once (immediate-treatment) or twice (delayed-treatment) prior to the start of therapy. After that, assessments take place at 3, 6 and 12 months after the first/second assessment, regardless if treatment is continued or ended. Adverse events, as detected by the clinician or research associates, will be reported to the parents immediately and recommendations on further actions will be given. If stuttering is no longer the main focus in treatment, clinicians inform the research team that the child will drop out of the study but continue treatment in a different manner. All treatments will be continued, if necessary, after the 12 months follow-up.

Participation in the study is terminated prematurely or subjects are excluded from the study if the therapy is interrupted for more than 6 weeks at a time or if no data collection is possible at two consecutive assessment times. As soon as the treating therapist classifies the KIDS therapy procedure as not or no longer indicated, he informs the project coordinator and arranges for the subject to withdraw from the study. The same applies in the event that the parents want a different therapy method or a change of therapist.

### **Data management and statistical analysis**

#### ***Data management***

The names and personal data of the subjects are collected by the primary investigator and coordinator and stored pseudonymised in a shared database of the Münster University of Applied Sciences. Each child is assigned a code (e.g. PMS-KIDS\_01) from which no conclusions can be drawn about his/her identity. The code for decrypting the personal data is only available to the primary investigator and coordinator and is kept locked on a local computer that is not connected to the network.

All other data collected from the assessments are stored and evaluated in a separate database in pseudonymised form, so that no conclusions can be drawn about the identity of the participating children. When analysing the data and exchanging results between the participating institutions, only the pseudonymised data are used. All participants in the study are subject to confidentiality. The data will be stored for a period of 10 years after collection and then irrevocably deleted. If the consent is revoked, the data already collected will be deleted or only collected data will be used and no further data will be collected and used, depending on the participant's wishes.

The study results are published as group data in an anonymous form at conferences and in journals, so that no conclusions can be drawn about the identity of the clinicians and subjects involved. Compliance with the Data Protection Act is fully ensured.

#### *Sample size calculation*

To determine the sample size, an a priori power analysis was carried out using the G\*Power program (Faul, Erdfelder, Buchner, & Lang, 2009). The alpha level was set at  $\alpha = 0.05$  and the power ( $1-\beta$ ) at 0.8. The expected effect relates to the primary outcome measure, the OASES-S. In the power analysis, the effect after 3 months was considered decisive, since at this point in time a comparison with the control group is made and after 12 months of therapy the expected effects will be greater anyway. When determining the effect size, the only studies in which the OASES-S was used during the course of therapy were taken into account: after 2 weeks of intensive therapy for stuttering adolescents and adults, the changes in the OASES-A (adult version) showed very large effect sizes after 12 months ( $d = 1.37$ ) (Euler, Anders, Merkel, & von Gudenberg, 2016). In an unpublished diploma thesis by Zang at the RWTH Aachen (2008), 10 children between the ages of 9 and 16 showed a 17% decrease in the point values after 10 therapy sessions of outpatient, extensive therapy (preliminary version of the OASES-S: AKES), which corresponded to a medium effect ( $d = 0.45$ ). The mean values and standard deviation of these children at the start of therapy were slightly above the reference values of the American norm sample and a Dutch validation study in which the children were already being treated therapeutically. If the effect size was set at  $f = 0.2$ , the power analysis with the  $\alpha$  and  $\beta$  values given above resulted in a necessary sample size of 52 subjects in total.

#### *Statistical Analyses*

Planned statistical analyses include descriptive and inferential analyses using the software SPSS. For all primary and secondary outcomes, a 2-way repeated-measures ANOVA (group, assessment occasion) will be calculated. For the changes after 3 months (without a control group) data of the treatment arms will be combined and analysed together. Ancillary analyses include correlation analysis of (1) the outcomes at the individual assessment points and (2) the changes in the outcomes over time with initial severity as predictor.

All speech samples will be analysed by the research associates. To ensure sufficient inter- and intrarater agreement of the analyses, 30% of the speech samples are analysed by both employees (inter-rater agreement) and a further 30% after 1 month (intra-rater agreement). At least 90% agreement is required for satisfactory agreement.

#### **Quality assurance**

The study is designed as a multi-centre clinical trial under everyday conditions while ensuring that requirements for good clinical practice are met. Foremost, this includes the protection of the participating children, including their parents. Possible risks and burdens are considered in detail and weighed up against the benefits of participating in the trial (see Safety considerations). Children and their parents will be informed about the study orally as well as in written form (Informed consents) and are not disadvantaged in care if they refuse participation. Clinicians and scientific staff evaluate thoroughly if randomisation and possible waiting time is reasonable for a given child and his/her family. If not, the need for immediate treatment is prioritized.

The quality of care is ensured by a detailed treatment manual, training of the clinician and supervisions on a regular base. Assessments follow a standardized protocol and are designed to deliver valid data while ensuring a child-oriented approach. Standardization is considered very important due to different research associates collecting data and multiple participating speech centres and clinicians. However, at all times, refusal of a child and/or parent during data collection is accepted and their interests prevail over the scientific interests of the study. Data management of the study (see Data management) ensures secure handling and storage of data, which is also described in detail in the proposal for the ethical committee and the informed consents.

## **Expected outcomes of the study**

The results of this study provide the first insights as to whether outpatient speech therapy care for stuttering primary school children is sufficiently effective. Detailed results with regard to speech fluency but above all ICF-oriented activities and participation can be expected from this study. In this scope, the data obtained relate directly to the (German) care situation under everyday conditions and can therefore answer important questions for those affected, service providers and cost providers:

1. Are the effect sizes of outpatient, extensive individual therapies for stuttering, primary-aged children after 12 months comparable to the effects after intensive group therapies known from the literature?
2. How effective are stutter modification therapies in older children with advanced chronicity and in which aspects of the symptoms can the greatest therapeutic effects be expected?
3. What effects can be expected from the current specifications of the catalogue of remedies for stuttering therapy in primary school children?

After the end of the funding, further studies based on the findings would be desirable in order to more specifically examine the proportion of effects of group therapy compared to individual therapy and the relative effectiveness of extensive versus intensified therapy. Incidentally, these are aspects that are also rather unknown for other speech therapies. Thus, this study also has a very large exploitation potential with regard to the feasibility of effectiveness studies on speech therapy measures under everyday conditions.

## **Dissemination of results and publication policy**

Due to the high exploitation potential, the results will be disseminated nationally and internationally at conferences and in specialist journals. In addition, the results are of great importance for future speech therapists and will find their way into speech therapy training and university teaching. It is planned to make the treatment manual available to other clinicians.

In all publications the research team members will be listed as authors. The primary investigator will take lead in publication and be first author while the second investigator will be senior (last) author in publications to scientific media. Dr. Franken who supports the study with methodological advice will take part in the main publication as author.

## Duration of the project

Milestones	04/2018	01/2019	02/2019	03/2019	04/2019	01/2020	02/2020	03/2020	04/2020	01/2021	02/2021	03/2021
Ethical approval in Münster is obtained; Ethical approval in Aachen is applied for	Oct 18											
Manual developed	Nov 18											
Training completed with 16 clinicians	Nov 18											
Ethics vote Aachen is obtained		Jan 19										
Supervision meetings planned		Mar 19										
Second training completed with 16 clinicians			Apr 19									
25 children included in the study			May 19									
Training in analysis of speech samples completed				Aug 19								
Last child included in the study (last patient in)					Dec 19							
Data collection T0 completed						Jan 20						
Data collection T1 completed (+3 months)							Apr 20					
Data collection T2 completed (+6 months)								Jul 20				
Data analysis started									Dec 20			
Data collection T3 completed (+12 months)										Jan 21		
Data collection T4 completed (+ 15 months)											Apr 21	
(statistical) Data analysis completed												Jul 21
Manuscript submitted for publication												Sep 21

## Problems anticipated

The typical risk factors of a multicentre, prospective long-term care study are subject recruitment, incomplete data sets and drop-outs, especially at the end of the study.

The risk of sufficient recruitment of participants was comprehensively analysed via the survey carried out in advance (Kohmäscher, 2017) and the design of the study was developed with this knowledge gained. The survey showed, among other things, that speech therapists were very willing to take part in the present study. In addition, the recruitment of participants is supported by relevant associations such as the *Interdisciplinary Association of Stuttering Therapists (ivs e.V.)*, *Federal Association for Stuttering and Self-Help (BVSS e.V.)* and the *German Federal Association for Speech Therapy (dbf e.V.)*. Age-specific data on clients in speech therapy centres as well as the frequency of new admissions are available and the recruitment period of 17 months has been tailored to this. In addition, the inclusion criteria for the study were deliberately kept liberal in order to maximize the number of subjects and to obtain realistic, meaningful data.

The collection of complete data sets is to be ensured by the following measures: data are collected by the parents of the children treated, but at the same time data is collected by scientific staff on site, in the treatment facilities. This minimizes the time and financial effort for the families involved. At the same time, the on-site assessments intensify contact with the clinicians involved, problems in the course of the study can be discussed face-to-face and can thus be solved more quickly. The attitude of the treating clinicians towards the study is seen as a key variable for the compliance of the subjects. For this reason, the compliance of the clinicians is explicitly promoted through initial training, supervision meetings and/or telephone calls, low-threshold responsiveness and a reduction in the study-related effort.

Finally, it is known from health services research that due to the diverse heterogeneous conditions on site, everyday effects are often less pronounced than in efficacy studies with more rigorously controlled conditions. This "*effectiveness gap*" must be taken into account and discussed in particular when interpreting the data.

## Project management

The primary and secondary investigator share responsibility for the conceptualization and design of the study. The project management is primarily task of the primary investigator with regular and close alignment with the secondary investigator. The secondary investigator takes a leading role in the statistical analysis of the data.

Shared responsibilities: funding, conceptualization and design of the study, project management, (statistical) data analysis, publication

Parts of project management, monitoring and coordination will be delegated to the project coordinator:

- Coordination of data collection (including scheduling, standardization and quality assurance, securing required resources)
- Ensuring time-bound compliance with milestones
- Checking of collected data with regard to quality and completeness
- Creation and maintenance of a database
- Contact person for participants
- Settlement of travel and hotel costs, expense allowances
- Organization of training and supervision
- project coordination with principal investigators
- Supporting publications

Furthermore, each one research associate (doctoral student) will be hired for 3 years at the Münster University of Applied Sciences and the University Hospital of the RWTH Aachen University.



The project-related tasks of the research associates are identical:

- Supporting recruitment of participants
- Preparation and implementation of nationwide data collection
- Entering data into the database
- Data analyses

A doctoral graduation in a project-related topic is desired and will be mentored by the second investigator.

Student assistants will be hired at both sites. The project-related tasks include:

- Viewing and processing literature
- Support in preparing for data collection (e.g. providing questionnaires, ensuring the functionality of equipment)
- Planning of travel activities of the scientific staff
- Documentation of travel activities for accounting
- processing of data

## Ethics

### *Informed consent process*

Information and education aims at two different target groups: At the beginning of the study, we will recruit nationwide speech language therapists who work in outpatient directed settings. They will be informed in detail about the study, the conditions of participation and their rights (informed consent clinicians). By providing oral and written consent, these clinicians agree for the recruitment period (15 months) to the following procedure concerning parents who apply for stuttering treatment in their centre:

If parents of children who stutter apply for stuttering treatment the clinician will check during the first contact if the child fits into the inclusion criteria and comes into consideration for study participation. If this is the case, the clinician will inform the parents about the study and ask them whether written informed consent may be sent to them and contact details may be forwarded to the project coordinator (informed consent PMS KIDS parents).

The process of consent to the study for the parents only begins when the initial telephone contact between the treating clinician and the parents reveals that the child meets the inclusion criteria and is eligible for study participation (see *Procedures*). If the parents are interested in participating in the study, a telephone consultation will be held in which detailed information about the study and the conditions for participation will be provided and questions will be answered. The parents are informed that the treatment carried out is standard treatment and that participation in the study will not result in any (adverse) changes to the therapy. Furthermore, the parents are informed that participation in the study is absolutely voluntary and that participation in the study can be terminated at any time without disadvantages for further treatment. The first data collection (T0) before the start of therapy will only take place if written consent from parents and child to participation in the study is available.

### *Other ethical considerations*

The most relevant ethical considerations included 1) the protection the children and their parents and 2) randomisation procedures. The considerations are reported in detail under *Safety considerations*. Ethical votes for both investigating sites will be obtained prior to start of the trial.

### *Informed consents*

Informed consents of the participating clinicians are collected prior to the recruitment of parents resp. children who stutter (informed consent PMS KIDS clinicians).

After the verbal education via phone, the parents are sent a generally understandable informed consent with a declaration of consent in duplicate for parents and child (informed consent PMS KIDS parents, informed consent PMS KIDS children). The parents are given sufficient time to read the documents at home, to inform their child, to clarify questions together and, based on

sufficient information, to decide whether or not to participate in the study. Parents and children are explicitly informed in the declaration of consent that their consent to participate in the study is voluntary and can be revoked at any time without fear of any disadvantages. An appointment for the first data collection (T0) before the start of therapy is only made when the project coordinator has received written consent to participate in the study. Before the start of the data collection, the examiner verbally informs the child about the content of the informed consent and ensures that the child has sufficiently understood his or her rights. Data collection does not begin until the child verbally confirms their participation in the study. The declarations of consent are filed and stored separately from the data collected at the Münster University of Applied Sciences. They are only accessible for the project leader and coordinator in order to ensure that the data are pseudonymous.

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