Self-Fitting (SF) Strategy Validation
NSR Device Study Protocol: *SF* Study

Protocol Number: D00232675

National Clinical Trial (NCT) Identified Number: 04972162

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NSR Device Sponsor: WSAUD A/S

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Summary of Changes from Previous *Version 1.0 dated 25 May 2021*:

Affected Section(s)	**Summary of Revisions Made**	**Rationale**
Title Page	Updated NCT Identified Number to: 04972162	Received it after IRB approval of the study
Title Page	Updated FINAL Version Number and Date to: v. 1.1 and 08 September 2021	Updated due to minor protocol amendment
All Headers	Updated Version Number and Date to: 1.1 and 08 September 2021	Updated due to minor protocol amendment
9.4.2.1	Corrected (i.e., yellow highlighted parts) weighted harmonic mean (WHM) formula to show the WHM of a set of p-values is the reciprocal of the WHM of the reciprocals of these p-values. $pWHM = \sum wi / \sum (w_i / p_i)$ i=1….L	While typing the formula, typing errors occurred
9.4.2.1	Corrected to L=3	Typing error occurred
9.4.2.1	Added: The weights (w_i) are set equal to 0.3333… We weight them equally because the scores are calculated with each component weighted equally.	Specify how the three p-values will be weighted.

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STATEMENT OF COMPLIANCE

This non-significant risk (NSR) device study will be carried out in accordance with *Clinical Investigation of Medical Devices for Human Subjects – Good Clinical Practice* (ISO 14155 Third edition 2020-07) and the following:

- United States (US) Code of Federal Regulations (CFR) applicable to NSR device studies (21 CFR Part 50, 21 CFR Part 56, 21 CFR Part 812.2(b))

The protocol, informed consent form (ICF), recruitment materials, and all subject materials will be submitted to the Institutional Review Board (IRB) for review and approval. Approval of both the protocol and the consent form must be obtained before any subject is enrolled. Any amendment to the protocol will require review and approval by the IRB before the changes are implemented to the study. In addition, all changes to the consent form will be IRB-approved; a determination will be made regarding whether a new consent needs to be obtained from subjects who provided consent using a previously approved consent form.

1 PROTOCOL SUMMARY

1.1 SYNOPSIS

Title:	Self-Fitting (SF) Strategy Validation NSR Device Study Protocol: ***SF* Study**
Study Description:	A prospective, randomized controlled, adaptive design, non-inferiority, pre-market and NSR device study. To be conducted in a minimum of 28 adult subjects with mild-to-moderate hearing loss to validate the effectiveness of the *Vibe SF* strategy. Validation measures subject´s perceived hearing aid benefit when using the *Vibe SF* self-fit hearing aids and when using Silk 1X Hearing Care Professional (HCP) fit hearing aids. The study begins with a cross-over design. At the interim analysis, the possibility of an interaction effect is evaluated through a nuisance parameter. If it is determined to be likely, the design is switched to a parallel-group design with a larger sample size. Only data from the first period will be included from those subjects who early on participated in the cross-over design. The Silk 1X HCP fit hearing aids are fitted to National Acoustic Laboratories Nonlinear Version 2 (NAL-NL2) prescriptive targets, verified by probe-mic real-ear measures (REM). The null hypothesis (H_0) is that subject´s perceived hearing aids benefit using *Vibe SF* hearing aids is inferior to Silk 1X HCP fit hearing aids, and the alternative hypothesis (H_a) is that subject´s perceived hearing aids benefit using *Vibe SF* hearing aids is non-inferior to that using Silk 1X HCP fit hearing aids.

Description of Study Intervention:	The mechanism for validating the *Vibe SF* strategy will be to compare subject´s perceived hearing aid benefit after two 14 days series of using *Vibe SF*/Silk 1X HCP fit hearing aids.
Objectives:	**Primary Effectiveness Objective:** To demonstrate that the *Vibe SF* strategy is non-inferior to the HCP fit strategy in subject´s perceived hearing aid benefit after using the *Vibe SF* and Silk 1X HCP fit hearing aids in real-life conditions. **Secondary Hearing Aid Benefit Objectives:** To score each of the following hearing aid benefit performance measures when the subject is using the *Vibe* SF and Silk 1X HCP fit hearing aids: 1. Sound quality, speech understanding and hearing aid satisfaction real-time assessment, 2. Speech-in-noise recognition performance, and 3. Hearing disability in communication situations. **Secondary Gain Selection Objective:** Individual frequency-specific real-ear gain comparison of the two different fitting strategies (*Vibe SF* and HCP fit). **Secondary Preference Objective:** Fitting strategy (*Vibe SF* or HCP fit) preference reported by the subject. **Secondary Safety Objective:** To estimate the rate of adverse device effects (ADEs) when the subject is using the *Vibe SF* hearing aids.
Endpoints:	**Primary Effectiveness Endpoint:** Differences in the benefit scores on each of the three communication subscales as captured by the Abbreviated Profile of Hearing Aid Benefit (APHAB) after wearing each *Vibe SF*/ Silk 1X HCP fit hearing aids for 14 days. For each subject, the endpoints are the individual 3 communication subscale differences between the HCP fit subscale (benefit) score and SF subscale (benefit) score: • $\Delta EC(benefit)_{HCP\ fit} - \Delta EC(benefit)_{SF}$ • $\Delta BN(benefit)_{HCP\ fit} - \Delta BN(benefit)_{SF}$ • $\Delta RV(benefit)_{HCP\ fit} - \Delta RV(benefit)_{SF}$ **Secondary Hearing Aid Benefit Endpoints:**

1. The subject´s sound quality, speech understanding and hearing aid satisfaction Ecological Momentary Assessment (EMA) ratings measured repeatedly under real-life conditions,
2. Speech-in-noise recognition performance as measured by the Quick Speech-In-Noise test (QuickSIN),
3. Hearing disability resulting from hearing loss quantified by the short form of the Speech, Spatial, and Qualities of Hearing Scale for clinical use: the SSQ-12 questionnaire.

Secondary Gain Selection Endpoint:
Individual frequency-specific gain comparison for the two different fitting strategies (*Vibe SF* and HCP fit) for each ear as measured with probe-mic real-ear measures (REM).

Secondary Preference Endpoint:
Fitting preference *Vibe SF* or HCP fit strategy. Subjects are asked which of the hearing aids they would prefer to keep using a 5-point Likert scale.

Secondary Safety Endpoint:
The number of adverse device effects (ADEs) in the time period when the subject is using the *Vibe SF* hearing aids.

Population: A minimum of 28 US subjects, within the age of 18 years and older, inexperienced or experienced hearing aid users with perceived mild-to-moderate hearing impairment. Potential subjects will be screened to confirm their bilateral sensorineural hearing loss.

Description of Sites/Facilities Enrolling Subjects: A single US University hearing aid research clinic. Potential subjects will be recruited locally by outreach at the investigator sites, local advertisements, social media advertisements and if needed professional recruiting service.

Study Duration:

Adaptive Design: IF no significant Interaction Effect

28 Subjects: Cross-over design

Enrollment (Visit 1)	30 days	4 weeks
Field Tests	28 days (+6 days)	4 weeks
2 weeks Field Test 1 +3 days, 2 weeks Field Test 2 + 3 days		
Follow-up (Visit 2)	1 day (+7 days)	
Washout Period	5 days (+2 days)	1 week
Follow-up Visit (Visit 3)	1 day (+7 days)	
Interim analysis of nuisance parameter (interaction effect)	0 (done in parallel during Field Test 1)	0
Completion of data analysis	90 days	12 weeks

TOTAL Duration	155 days (+22 days)	25 weeks/6 months

Adaptive Design: IF significant Interaction Effect

12 Subjects: Cross-over design

Enrollment (Visit 1)	30 days	4 weeks
Field Tests	28 days (+6 days)	4 weeks
2 weeks Field Test 1 +3 days, 2 weeks Field Test 2 + 3 days		
Follow-up (Visit 2)	1 day (+7 days)	
Washout Period	5 days (+2 days)	1 week
Follow-up Visit (Visit 3)	1 day (+7 days)	
Interim analysis of nuisance parameter (interaction effect)	0 (done in parallel during Field Test 1)	0
Subtotal Duration	65 days (+22 days)	13 weeks/3 months

38 Subjects: Parallel-arm design

Enrollment (Visit 1)	30 days	4 weeks
Field Test 1	14 days (+3 days)	2 weeks
Follow-up (Visit 2)	1 day (+7 days)	
Completion of data analysis	90 days	12 weeks
Subtotal Duration	135 days (+10 days)	18 weeks/4.5 months
Grand TOTAL Duration	200 days (+32 days)	31 weeks/7.5 months

Subject Duration:

Adaptive Design: IF no Significant Interaction Effect

28 subjects

Each subject receives both treatments (cross-over design)

7 weeks total study duration on-study per subject

Adaptive Design: IF significant Interaction Effect

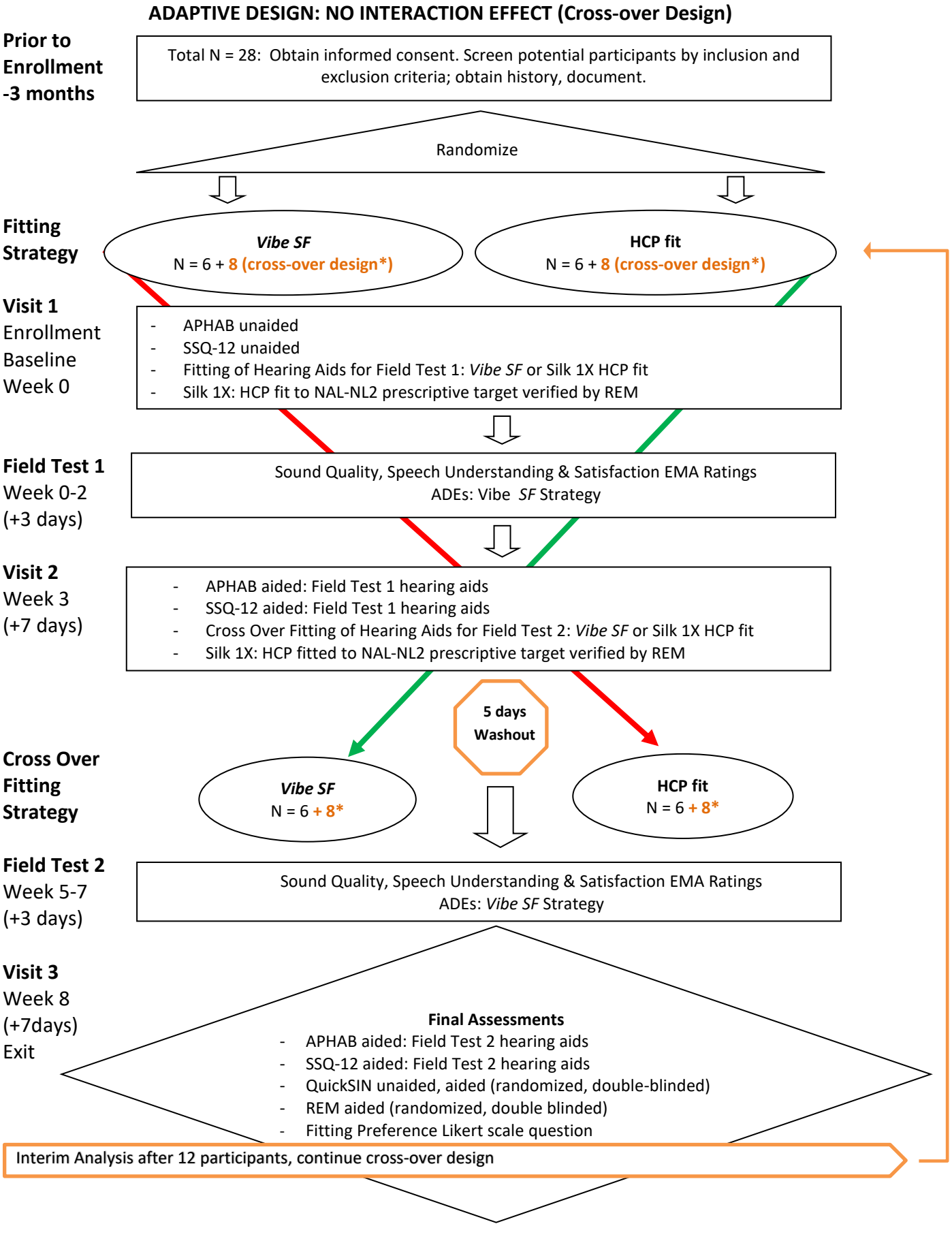
50 subjects:

- Before the interim analysis, 12 subjects get both treatments (cross-over design)
- After the interim analysis, 38 subjects get one treatment (parallel-arm design)

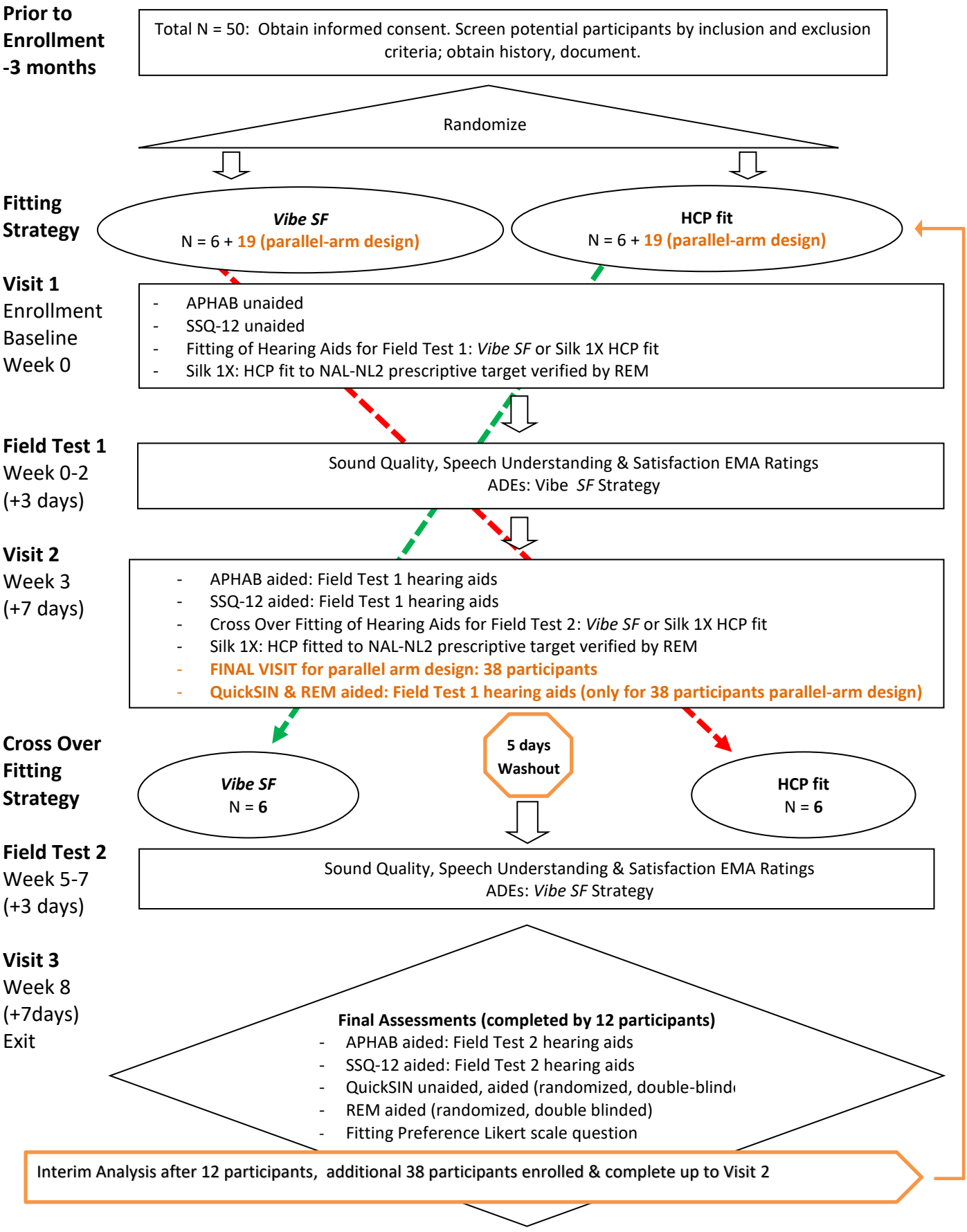
12 subjects get both treatments = 7 weeks total study duration on-study per subject

38 subjects get one treatment = 3 weeks total study duration on-study per subject

1.2 SCHEMA



ADAPTIVE DESIGN: INTERACTION EFFECT DETECTED (Parallel-arm Design)



Schedule of Activities (SoA)

Procedures	Screening - 3 months	Enrollment/Baseline Visit 1, Week 0	Field Test 1 Week 1-2 +3 days	Study Visit 2 Week 3 +7 days	Washout Period 5 days + 2 days post Visit 2	Field Test 2 Week 4-5 + 3 days	12 subjects completed Visit 3	Study Visit 3 Day 30 + 7 day
Inclusion/Exlusion Criteria	X							
Demographic (e.g., gender)	X							
Medical history (e.g., Length of hearing loss, length of hearing aid use)	X							
Self-perceived hearing loss rating	X							
Hearing Test	X							
Informed consent	X							
Randomization		X						
APHAB unaided		X						
SSQ-12 unaided		X						
Bilateral Hearing Aid fitting:								
Silk 1X Issued, HCP fit strategy: NAL NL2 REM		(X)		(X)				
Vibe SF Hearing Aids Issued, SF strategy		(X)		(X)				
Shipment and Delivery of Field Test 2 Hearing Aids at 5 days + 2 days post Visit 2					X			
APHAB aided				X				X
SSQ-12 aided				X				X
Sound quality, speech understanding and hearing aid satisfication EMA			X			X		
Follow-up Call: EMA data collection (+3 days Field Test 1 & 2)			X			X		
QuickSIN, unaided								X
QuickSIN, aided, hearing aid order randomized, double-blinded								X
QuickSIN, Field Test 1 device (parallel-arm design)				**X***				
REM, hearing aid order randomized, double-blinded (cross-over design)								X
REM, Field Test 1 device (parallel-arm design)				**X***				
Fitting Preference Likert question								X
Adverse device effect (ADE) review and evaluation		X	X	X		X		X
Complete electronic Case Report Forms (eCRFs)	X	X	X	X		X		X
Final Study Visit at Visit 3 for 28 subjects (cross-over design)								**X***
Final Study Visit at Visit 2 for 38 subjects (parallel-arm design)				**X***				
Final Study Visit at Visit 3 for 12 subjects (parallel-arm design)								**X***
Interim Analysis: Interaction Effect Detection on 12 subjects							**X**	

***(X)**: Visit 1: Device Fitting Strategy order randomly issued to subject. Visit 2: Cross Over to other Device Fitting Strategy*

X: Adaptive design: detection analysis of significant interaction effect impacting sample size and study design (cross-over vs parallel-arm design)*

2 INTRODUCTION

2.1 STUDY RATIONALE

Having reliable access to hearing health care services in the United States does not equate that individuals with hearing impairment will purchase and use hearing aids. Today, an estimated 3.4 million people in the US experience hearingstudy difficulties, have an objectively measurable hearing loss, but still do not use any device to mitigate their hearing loss problem. There are many reasons that an individual does not pursue adopting a hearing healthcare solution. Accessibility and affordability are two of the main reasons reported in the latest MarkeTrak 10 survey (Edwards, 2020). The stigma associated with hearing aids, lack of awareness or lack of confidence that hearing aids would help are other reasons.

Self-fitting (SF) hearing aids address primarily the accessibility and affordability issues. These SF hearing aids may expand the reach of hearing health care by meeting the unmet needs of a segment of people with hearing loss who, until now, have rejected traditional hearing aids.

The Sponsor is conducting this NSR device study to fulfill one of the special controls, 21 CFR § 874.3325(b)(1) *Clinical data must evaluate the effectiveness of the self-fitting strategy…*for self-fitting air conduction hearing aids. The primary purpose of the SF Study is to validate the effectiveness of the *Vibe SF* strategy based on the device's intended use and technological characteristics. The SF Study final clinical study report will be part of the 510(k) submission for the *Vibe SF* hearing aid.

2.2 BACKGROUND

The Original Hearing Aid Act in 1977 led the FDA to designate hearing aids as medical devices. Hearing Aids were listed under the Food and Drug Administration Modernization Act of 1997 (FDAMA) or the 21st Century Cures Act of 2016 as exempt from premarket notification requirements. In October 2018, the FDA established the new Class II device type, self-fitting air conduction hearing aid (21 CFR § 874.3325) with special controls.

SF strategy clinical data are described by Sabin et al. (2020) who conducted a similar validation investigation on the predicate device, the self-fitting and direct-to-consumer (DTC) BOSE® Hearing Aid (DEN180026, 2018).

The Sponsor believes that a 510(k) clearance of this SF device supports its positioning to fulfill the upcoming FDA proposed rule on Over-the-Counter (OTC) hearing aids as required in the 2017 Over-the-Counter (OTC) Hearing Aid Act.

2.3 RISK/BENEFIT ASSESSMENT

2.3.1 KNOWN POTENTIAL RISKS

The risk management process for the self-fitting hearing aid system is performed in accordance with the requirements stated in ISO 14971:2007, and the risk analysis results are used to identify and implement appropriate product development activities. The risk analysis in the Risk Management File for the self-fitting hearing aid system conducted by SPONSOR includes the identified risks in 21 C.F.R. § 874.3325 and in the validation investigation on the predicate device, the self-fitting and direct-to-consumer (DTC) BOSE® Hearing Aid (see Appendix 1).

Table 1 below lists the identified risks related to the self-fitting system of the *Vibe SF* hearing aid and *EasyFit* web application (*EasyFit*).

Mitigations to prevent over-amplifications include a safety output limiter which is a hardware measure for limiting the output sound pressure level (OSPL) in failure mode. Hence, for the implemented cluster, the safety limiter is 6 dB above maximum OSPL of the specific cluster. Other mitigation measures include performance testing as electroacoustics and software verification and validation. Critical use-related scenarios (critical tasks) and essential functions have been identified and will be tested and validated in Human Factors testing.

Table 1. Overview of identified risks related to self-fitting system clinical study

Identified Risk	Mitigation Measures	Support
Diminished hearing due to over-amplification caused by: • Excessively high sound output levels in the ear canal	• Software verification and validation (performance testing) • Electroacoustic (performance testing) • Safety Limiter implemented in design • Maximum possible output 114 dB • Screening of subjects to confirm mild-to-moderate hearing loss	• ANSI S3.22 electroacoustic testing
Diminished hearing due to over-amplification caused by: • Confusing and switching left and right hearing aid	• Safety Limiter implemented in design Labeling • IFU and Workflow show Left/Right Hearing Aid (Labeling) • L/R mark on the device to distinguish between left and right hearing aid	• Software verification and validation (performance testing) • Design verification
Listening fatigue or failure to provide sound awareness due to over- or under-amplification caused by: • Poor fitting • Use error • Confusion L/R	• Software verification and validation (performance testing) • Electroacoustic (performance testing) • Safety Limiter implemented in design Labeling • IFU and Workflow show Left/Right hearing aid (Labeling) • L/R mark on the device to distinguish between left and right hearing aid	• Software verification and validation (performance testing) • Human factors validation • Pilot Study

Identified Risk	Mitigation Measures	Support
Diminished hearing due to unintended use as hearing protection in loud environments.	Labeling • Do not use this device as hearing protection in loud environments. • Frequent exposure to loud sounds may harm your hearing. Keep the loudness at comfortable listening levels. Wear hearing protection when exposed to loud environmental noise.	• Human factors validation
• Wrongly treated hearing loss • Unintended user (severe hearing loss) selects the SF hearing aid despite having a severe hearing loss. Severe hearing loss remains untreated and worsens.	• Labeling • Web application has built in measures if the response is outside the fitting range. • Screening confirms that subjects have mild-to-moderate hearing loss	• Human factors validation • Software verification and validation (performance testing)
Diminished hearing due to over-amplification caused by: • Hearing ability profiling: Intended user does not count how many tones he / she hears leading to wrong clusters selected.	• Built-in measures in the web application to check consistency in the answers of the users on how many tones heard. • Comfort loudness adjustable by the user after the hearing ability profiling. Labeling • Perform the hearing ability profiling in a quiet environment without interruptions for the best result.	• Human factors validation • Software verification and validation (performance testing)
Acoustic Smartphone App can provide a high sound pressure level (SPL) / output to the patient's ear causing discomfort in the ear.	The tones are extremely short and not perceived by most people These types of remote controls have been marketed for many years and proven to be reliable and safe Labeling • The smartphone generates short tone sequences to control the hearing aids. Do not hold the smartphone close to the ear while using the app.	• Human factors validation

2.3.2 KNOWN POTENTIAL BENEFITS

Hearing aids relieve the strain of hearing, i.e., less strain and more clear hearing. It is anticipated that inexperienced wearers will experience improved ease and better speech understanding in various listening environments, e.g., watching television, conversations.

Subjects get the chance to try out state-of-the-art modern hearing aids. Inexperienced hearing aid subjects gain experience with hearing aids which will help them to make an informed choice if they decide to

purchase hearing aids upon conclusion of the study. Subjects already fitted with hearing aids will gain experience with SF hearing aids as well as the instant-fit completely-in-canal (CIC) form factor.

During screening the hearing of the subjects is checked by HCP thus the subjects gain current information about the status of their hearing.

Having to fill out the EMA surveys daily may have the benefit that subjects pay more attention to their hearing which might lead to increased perceptiveness of sound being an incentive to become more socially active. Overall, this could contribute to their emotional well-being.

2.3.3 ASSESSMENT OF POTENTIAL RISKS AND BENEFITS

Overall, all risks identified are mitigated as low as possible / below the risk acceptability threshold. The risks associated with the use of the *Vibe SF* hearing aid system are acceptable when weighted against the expected benefits to the study subjects. The benefit outweighs the overall residual risk.

In conclusion, the overall residual risk and the overall risk/benefit profile is acceptable for the clinical study using the self-fitting system *EasyFit* web application and *Vibe SF* hearing aid.

3 OBJECTIVES AND ENDPOINTS

OBJECTIVES	ENDPOINTS	JUSTIFICATION FOR ENDPOINTS
Primary		
Primary Effectiveness		
To demonstrate that the *Vibe SF* strategy is non-inferior to the HCP fit strategy in subject´s perceived hearing aid benefit after wearing the *Vibe SF* and Silk 1X HCP fit hearing aids in real-life conditions.	Differences in the benefit scores on each of the three communication subscales as captured by the Abbreviated Profile of Hearing Aid Benefit (APHAB) after wearing each *Vibe SF*/ Silk 1X HCP fit hearing aids for 14 days. The three communication subscales on the APHAB are: ease of communication (EC), background noise (BN) and reverberant room (RV). There is one benefit score (i.e., = unaided - aided) for each communication subscale (EC, BN and RV) scored after each fitting strategy field testing (SF or HCP fit): $\Delta EC(benefit)_{SF}$, $\Delta BN(benefit)_{SF}$, $\Delta RV(benefit)_{SF}$ for the *Vibe SF* hearing aids, and $\Delta EC(benefit)_{HCP\ fit}$, $\Delta BN(benefit)_{HCP\ fit}$, $\Delta RV(benefit)_{HCP\ fit}$ for the Silk 1X HCP fit hearing aids.	Self-reporting questionnaires have been commonly used to measure subjective hearing impairment. The APHAB is selected because of its known psychometric properties. The APHAB was specifically designed to quantify auditory disability so that the success of the hearing aid fitting in reducing disability and comparison between hearing aid fitting strategies may be examined *(Cox & Alexander, 1995)* . The reason to examine each subscale independently is to investigate whether the fitting strategies provide different benefit in varying kinds of environments in the real world.

OBJECTIVES	ENDPOINTS	JUSTIFICATION FOR ENDPOINTS
	For each subject, the endpoints are the 3 communication subscale differences between the HCP fit subscale (benefit) score and corresponding SF subscale (benefit) score: • $\Delta EC(benefit)_{HCP\ fit}$ - $\Delta EC(benefit)_{SF}$ • $\Delta BN(benefit)_{HCP\ fit}$ - $\Delta BN(benefit)_{SF}$ • $\Delta RV(benefit)_{HCP\ fit}$ - $\Delta RV(benefit)_{SF}$ Time point data collected: Cross-over Design: Visit 1, 2, 3 Parallel-arm Design: 12 subjects: Visit 1, 2, 3 38 subjects: Visit 1 and 2	
Secondary		
Secondary Hearing Aid Benefit:		
To score each of the following performance measures when the subject is using the *Vibe SF* and Silk 1X HCP fit hearing aids:		
1. Sound quality, speech understanding and hearing aid satisfaction real-time assessment	The subject´s sound quality, speech understanding and hearing aid satisfaction Ecological Momentary Assessment (EMA) scores measured repeatedly under real-life conditions. Time point data collected: Cross-over Design: Field Test 1 and Field Test 2 Parallel-arm Design: 12 subjects = Field Test 1 and 2 38 subjects = Field Test 1	Assessment of perceived hearing aid benefit should include the dimension perceived sound quality, speech understanding and hearing aid satisfaction. Only a couple of studies have allowed users to make multiple adjustments or sound quality judgments under real-life conditions. We want to further the research on standardizing the sound quality and speech understanding satisfaction assessment questions asked in real-life conditions. The use of EMA ratings in audiology research is growing. Apps allow researchers to implement the EMA

OBJECTIVES	ENDPOINTS	JUSTIFICATION FOR ENDPOINTS
		methodology using smartphones in hearing aid outcome research (Wu, Stangl, Zhang, & Bentler, 2015). The EMA approach overcomes several long-standing problems in assessment. First, EMA minimizes the problem of retrospective memory biases in reporting long after specific behaviors or emotional reactions are emitted because respondents can be prompted during real-life situations (Schiffman, Stone, & Hufford, 2008). Users may remember recent events or very emotional events more than others. For hearing aid trials, this also means users may not remember the acoustical background of the situation. Secondly, EMA is representative of real life - surveys are not filled out in an artificial situation during an investigational site visit but rather are possible in many different situations in the life of the subjects. With random sampling (random triggers) it is possible to deduct how often each situation occurs in everyday life, but subjects can also trigger a survey in very important or difficult situations. Thirdly, EMA is context sensitive – subjects may have different needs and preferences in different situations. This can be measured with EMA as the user

OBJECTIVES	ENDPOINTS	JUSTIFICATION FOR ENDPOINTS
		can be asked what situation he/she is in right now. Subjects can for example pay attention to acoustical features, if the questionnaire asks for it.
2. Speech-in-noise recognition performance	Speech-in-noise recognition performance as measured by the Quick Speech-In-Noise test (QuickSIN) Time point data collected: Cross-over Design: 28 subjects Visit 3 Parallel-arm Design: 12 subjects Visit 3 38 subjects Visit 2	This is an objective measure of Hearing aid benefit with known psychometric properties to be comparable to related SF strategy research.
3. Hearing disability in communication situations	Hearing disability resulting from hearing loss quantified by the short form of the Speech, Spatial, and Qualities of Hearing Scale for clinical use: the SSQ-12 questionnaire Time point data collected: Cross-over Design: Visit 1, 2, 3 Parallel-arm Design: 12 subjects Visit 1, 2, 3 38 subjects Visit 1 and 2	This is a subjective measure of Hearing aid benefit with known psychometric properties to be comparable to related SF strategy research. The SSQ-12 (Noble, Jensen, Naylor, Bhullar, & Akeroyd, 2013) is selected as a verified tool to provide insights into other components of hearing function.
Secondary Gain Selection		
Individual frequency-specific real-ear gain comparison of the two different fittings (*Vibe SF*/HCP fit).	Individual frequency-specific real-ear gain comparison for the two different fitting strategies (*Vibe SF*/HCP fit) for each ear as measured with probe-mic measures (REM). Time point data collected: Cross-over Design: Visit 3 Parallel-arm Design: 12 subjects Visit 3 38 subjects Visit 2	Objective comparison of real-ear gain (Vibe SF vs. HCP fit) to characterize performance and establish the comparability of the *Vibe SF* and HCP fit parameters
Secondary Preference		

Fitting (*Vibe SF*/HCP fit) preference reported by the subject.	Fitting preference between the *Vibe SF* or HCP fit strategy. Subjects will be asked to give their response on a 5-point Likert scale to the following question: *Based on your listening experiences regarding speech understanding, sound quality and naturalness for both products, if you could keep one pair of these hearing aids, which would you choose?* Time point data collected: Cross-over Design: Visit 3 Parallel-arm Design: 12 Subjects: Visit 3	Assessment of perceived hearing aid benefit should include the dimension of fitting preference of the subject.
Secondary Safety Objective		
To estimate the rate of safety when the subject is using the *Vibe SF* hearing aids.	The number of adverse device effects (ADEs) in the time period when the subject is using the *Vibe SF* strategy hearing aids. Time point data collected: Cross-over Design: Visit 1-3, Field Tests 1-2 Parallel-arm Design: 12 Subjects: Visit 1-3, Field Test 1-2 38 Subjects: Visit 1 and 2, Field Test 1	Record, track and report device-related events as part of the risk management process for the SF strategy validation.

4 STUDY DESIGN

4.1 OVERALL DESIGN

The null hypothesis of the *SF* Study is that subject´s perceived hearing aid benefit using *Vibe SF* hearing aids is inferior to Silk 1X HCP fit hearing aids, and the alternative hypothesis is that subject´s hearing aids benefit using *Vibe SF* hearing aids is non-inferior to that using Silk 1X HCP fit hearing aids.

A prospective, randomized controlled, adaptive design, non-inferiority, pre-market and NSR device study. The first 12 subjects will participate in the cross-over design, after which an interim analysis of a nuisance parameter will be conducted to evaluate whether there is an interaction effect. If there is, the design will be changed to parallel-arm, the sample size will be increased to 50, and the remaining 38 subjects will

receive just one fitting (to which they are randomized). If there is no significant interaction effect, the 28 subjects originally planned will complete the cross-over design.

Cross-over design: 28 subjects

At the final Visit 3 the order of evaluating hearing aids (Vibe SF /Silk 1X HCP fit) will be randomized to ensure double-blinding to minimize subject and HCP bias while conducting the QuickSIN and REM laboratory assessments.

Parallel-arm design: 50 subjects

For 38 subjects, the final visit will be at Visit 2 and the REM and QuickSin will be tested with the Field Test 1 device. 12 subjects will complete the final visit where the order of evaluating hearing aids (Vibe SF /Silk 1X HCP fit) will be randomized to ensure double-blinding to minimize subject and HCP bias while conducting the QuickSIN and REM laboratory assessments.

This study has two fitting strategy groups, *Vibe SF* and HCP fit. In subjects who participate in the cross-over design, each subject is in each fitting strategy group for 14 days, 5-day washout period after cross over and total subject study intervention duration is 7 weeks. In subjects who participate in the parallel-arm design, each subject is in just one fitting strategy for 14 days. There is no washout period, and no cross-over to the other fitting.

A single US University hearing aid research clinic will be the clinical site in this study. The investigational site serves 15% Native American, 5% African American and other diverse American population.

The name of the self-fitting air conduction hearing aid is *Vibe SF*. The *EasyFit* web application is intended to support the SF strategy of the *Vibe SF*. The Vibe SF strategy is being evaluated in this study.
To address a possible significant interaction effect, a sample size re-estimation based on the nuisance parameter: interaction term will be conducted after 12 subjects have completed Visit 3.

4.2 SCIENTIFIC RATIONALE FOR STUDY DESIGN

Research of self-fitting hearing aids is limited, there is only one current published SF validation study done by the predicate device from Bose. Today the landscape of the hearing industry is changing quickly due to the rapid advancement of amplification technology as well as changes in federal regulations of the hearing aid market.

The sponsor does not know, before initiating the study, whether the interaction between treatment and order is significant. It is the company's belief that an interaction effect is unlikely because many studies in the hearing aid literature use cross-over designs, and none mention a significant interaction effect. Therefore, the company prefers not to start with the assumption that it is necessary to conduct a parallel-arm trial. To address concerns about a possible interaction effect, the sponsor proposes to address this potential problem by using an adaptive design: changing to a parallel-arm design based on a nuisance parameter. The nuisance parameter is the interaction term.

It is important to differentiate between traditional hearing aids and SF hearing devices, not only in terms of device characteristics but also in terms of expected subject outcomes. Also, it is important to differentiate the devices that produce the best patient outcomes across various listening situations. Therefore, there is a scientific need to develop an evidence base with well-controlled studies in relation to SF hearing aids.

Assessing the non-inferiority of the SF hearing to HCP fit hearing was the chosen study design because HCP counseling on hearing loss has been established in research as being best practice. In the rapidly changing distribution of model of hearing healthcare, it may become more likely a person with perceived hearing loss will utilize a self-fitting method as an introduction to hearing care. In the absence of a best practices model involving the HCP, it is necessary to verify that a hearing aid user's first experience with amplification is such that core expected benefits are met with a self-fitting approach. This does not prevent future intervention with a HCP. Rather, a self-fitting approach to amplification should provide noticeable benefit comparable to that of best practices to overcome key challenges of hearing loss directly related to reduced audibility. In this way, the new hearing aid wearer can begin experiencing benefits of amplification and develop a positive acceptance of hearing healthcare.

It cannot be expected for a SF hearing aid to be superior as the advantages of the SF lie in accessibility and ownership not the fitting-process itself. However, in the best interest of the subjects it has to be ensured that the hearing aid fitting is not inferior to that what they would get from the standard alternative, i.e., being fitted by a HCP.

4.3 END OF STUDY DEFINITION

28 subjects are considered to have completed the study when they have completed all phases of the study including the last visit shown in the SoA, Section 1.3.

In the event an additional 22 subjects are enrolled due to detection of significant interaction effect, these are considered to have completed the study when they have completed Visit 2. Refer to SoA, Section 1.3.

The end of the study is defined as the last subject's (minimum 24th subject, maximum 50th subject) completion of the last visit shown in the SoA in the study.

5 STUDY POPULATION

5.1 INCLUSION CRITERIA

In order to be eligible to participate in this study, an individual must meet all of the following criteria:

- Adults 18 years of age or older,
- Self-perceived mild to moderate hearing impairment,
- Signed informed consent form (ICF),
- Fluent in English listening and reading comprehension,

- With or without prior experience with hearing aids. At least four subjects and maximum 30% of the total number of subjects enrolled in this study will have prior hearing aid experience.
- Measured audiogram with at least four of the test frequencies 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, and 4000 Hz within fitting range of *Vibe SF* hearing aid (See Figure 1 below).

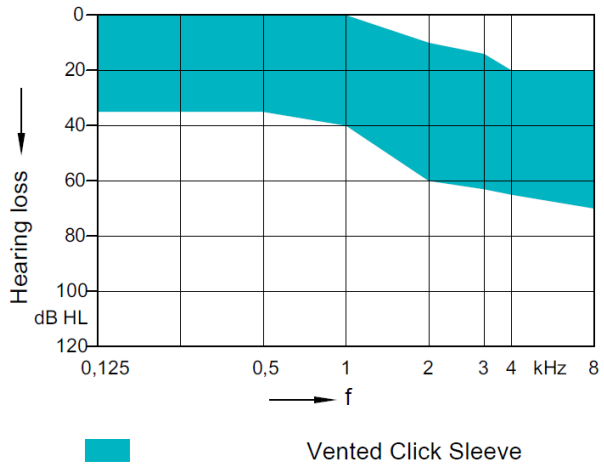


Figure 1. The colored area shows the fitting range of Vibe SF Hearing aids with the use of vented click sleeves; the hearing loss of the subjects should fall within that area.

5.2 EXCLUSION CRITERIA

An individual who meets any of the following criteria will be excluded from participation in this study:

- Silk 1X (HCP fit)/ *Vibe SF* hearing aids do not fit into the person's ears with any of the offered silicone 'Click Sleeves' instant ear tips.
- Abnormal conditions:
  - Severe hearing loss or deafness in at least one ear.
  - A steep decline in hearing ability within the last 90 days in one or both ears.
  - Active discharge within the last 90 days.
  - Dizziness.
  - A visible deformity of the ear.
  - Pain, or discomfort in the ear, or significant ear wax accumulation.
  - Audiometric air-bone gap equal to or greater than 15 decibels at 500 hertz Hz, 1,000 Hz, and 2,000 Hz.

5.3 SCREEN FAILURES

Screen failures are defined as subjects who consent to participate in the study but are not subsequently entered in the study. A minimal set of screen failure information is required to ensure transparent reporting of screen failure subjects, to meet the Consolidated Standards of Reporting Trials (CONSORT) publishing requirements and to respond to queries from regulatory authorities. Minimal information includes demography, screen failure details, eligibility criteria, and any serious adverse event (SAE).

5.4 STRATEGIES FOR RECRUITMENT AND RETENTION

The study will enroll a minimum of 28 US subjects and a maximum of 50 US subjects, 18 years of age and older, inexperienced or experienced (minimum 4, maximum 30% in total) hearing aid users with perceived mild-to-moderate hearing impairment that will be screened to confirm that s/he has bilateral sensorineural hearing loss.

Potential subjects will be recruited locally by outreach at the investigator site (i.e., a single US University hearing aid research clinic), local advertisements, social media advertisements and professional recruiting service. Advertisements will be reviewed and approved by the IRB to assure that they are not unduly coercive and does not promise a certainty of cure beyond what is outlined in the consent and the protocol. No claims will be made, either explicitly or implicitly, that the device is safe or effective for the purposes under investigation, or that the test article is known to be equivalent or superior to any other device. FDA considers direct advertising for study subjects to be the start of the informed consent and subject selection process.

Study subjects will be reimbursed for travel expenses for each clinic visit not to exceed $50/visit.
In case a subject withdraws from the clinical investigation the subject will receive transport compensation covering the number of times he/she has visited the investigation site during the clinical investigation.
As reimbursement for their time in filling out the EMA surveys and wearing the hearing aids during Field Test 1 & 2, and their testing time during Visit 1, 2, and 3, a total of US$175 will be paid out to 28 subjects as outlined below:

Table 2. *28 Subjects: cross-over design*

SCHEMA	Time	Amount	Payment
Screening	15 minutes	0	
Visit 1	60 minutes	15	
Field Test 1	14 days	40	55
Visit 2	60 minutes	15	
Field Test 2	14 days	40	55
Visit 3	120 minutes	65	65
TOTAL		**US$175**	**US$175**

Table 3. 50 Subjects: parallel-arm design
12 Subjects

SCHEMA	Time	Amount	Payment
Screening	15 minutes	0	
Visit 1	60 minutes	15	
Field Test 1	14 days	40	55
Visit 2	60 minutes	15	
Field Test 2	14 days	40	55
Visit 3	120 minutes	65	65
TOTAL		**US$175**	**US$175**

38 Subjects

SCHEMA	Time	Amount	Payment
Screening	15 minutes	0	
Visit 1	60 minutes	15	
Field Test 1	14 days	40	55
Visit 2	60 minutes	15	
TOTAL		**US$70**	**US$70**

6 STUDY INTERVENTION

6.1 STUDY INTERVENTION(S) ADMINISTRATION

6.1.1 STUDY INTERVENTION DESCRIPTION

The investigational device *Vibe SF* hearing aid is a NSR medical device that does not pose a significant risk to human subjects based on its intended use. The *Vibe SF* is intended to amplify sound for individuals 18 years of age or older with perceived mild to moderate hearing impairment. It is adjusted by the user to meet the user's hearing needs through software tools. The device is intended for direct-to-consumer (DTC) sale and use without the assistance of a hearing care professional (HCP). *Vibe SF* is intended to be sold as a binaural set and the Vibe SF strategy is intended to be binaural. The investigational device immediate package shall bear a label with the following statement: "CAUTION—Investigational device. Limited by Federal (or United States) law to investigational use."

The instant fit in-the-ear (ITE) style *Vibe SF* hearing aid uses silicone 'Click Sleeves' which are instant ear tips in four different sizes to provide comfort and secure device placement within the ear canal. The click sleeves are also used on the global market together with the Signia Silk Xperience devices (e.g., Silk 1X HCP fit control device) and other Signia products.

All hearing aids in the study are provided in black housing and marked with 'R' and 'L', for right and left side respectively, as displayed in Figure 2.

a) b) c)

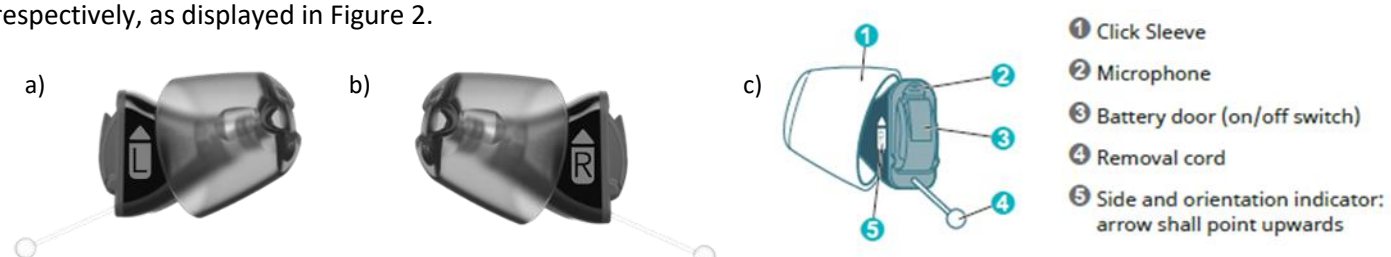


Figure 2. Drawings of the *Vibe Air* SF hearing aid: a) left side housing marked `L', b) right side housing marked `R', c) click sleeve, microphone, battery door, removal cord and side/orientation indicator.

The *EasyFit* web application is used to guide the user through the *Vibe SF* procedure and to set audiological gain parameters and preferred settings on the *Vibe SF*. *EasyFit* web application is designed to function in standard browsers of a user's compatible smartphone or tablet device. Access to the internet is required when using *EasyFit* web application during the SF procedure, fine-tuning and use of volume control.

Through the *Vibe SF* hearing aid, the *EasyFit* web application will present several sets of 2 or 3 tones to the subject for hearing ability profiling. Within such a test-tone-set all tones have the same frequency, but they differ in intensity level. Depending on the extent of hearing loss, the user will hear all, some or none of the presented tones. *EasyFit* web application will ask the user to enter the number of tones s/he hears. A selection of screen shots of the fitting process with the *EasyFit* web application are shown in Figure 3.

EasyFit web application can activate 4 different "clusters" in the hearing aid. "Clusters" in this context means different hearing aid settings. Those settings are the same with respect to hearing aid features, e.g., noise reduction etc., but they differ in frequency dependent gain, compression and MPO (maximum power output). *EasyFit* uses the result of the profiling procedure to select and activate the cluster and master gain setting that is most suitable for the user. In case of an asymmetrical hearing loss the cluster can differ across sides. A short additional test ensures the overall gain is comfortable and balanced between the left and right ears. After the fitting is completed, the user may further use *EasyFit* to fine-tune the hearing aid settings during daily use.

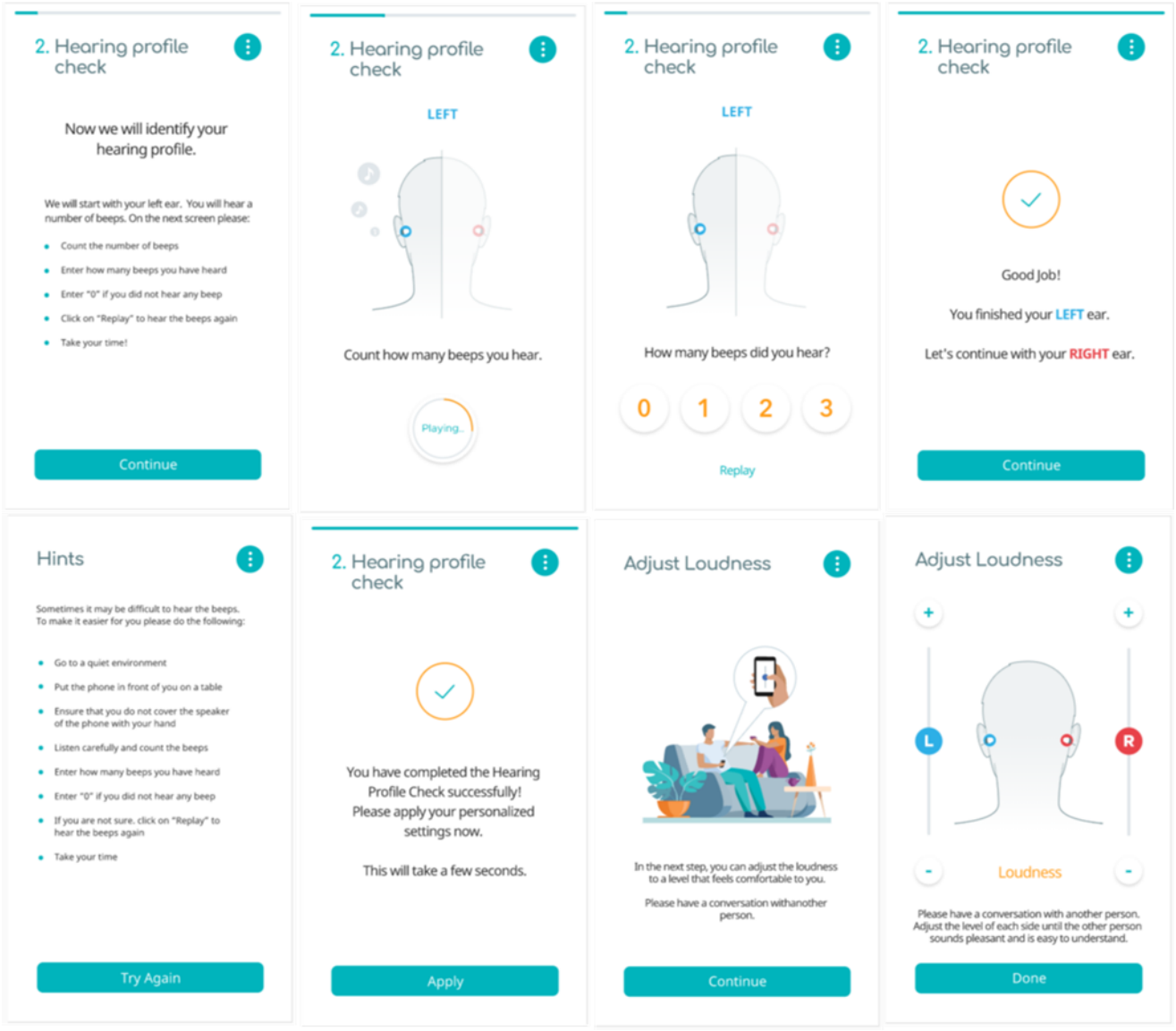


Figure 3 Selection of draft screenshots of hearing ability profiling in the *EasyFit* web application.

The control hearing aid device, Signia Silk Xperience, has been commercially available in the U.S. as a Class II 510(k)-exempt medical device since July 2020 in five models: Silk 7X, Silk 5X, Silk 3X, Silk 2X and Silk 1X. The performance levels for each model differ in the embedded software configuration but use identical hardware. The Silk 1X model will be fitted to the individual hearing thresholds by an HCP as per standard clinical care. The Connexx Fitting Software will be used to fit NAL-NL2 prescriptive target verified by probe-mic REM. The *Connexx* programming software allows the HCP access to certain programming parameters that are not accessible in the *Vibe SF* using *EasyFit*. Parameters that the HCP can adjust in the *Silk 1X* fitting are 8 adjustable gain and compression handles, Frequency Compression, Feedback cancellation (off, min, max). *Silk 1X* does support multiple programs, however only one single program (titled: universal program) will be used.

6.1.2 NONSIGNIFICANT RISK DETERMINATION

The Sponsor has determined that both the study and device are non-significant risk, based on the risk profile of this non-invasive device (see Appendix I), and a review of the Code of Federal Regulations definitions and rules regarding significant risk devices. The following rationale is cited as determination of non-significant risk:

> *The device does not meet the four elements of the definition for a significant risk device per 21 CFR 812.3, part (m) in that the device does not pose significant risk to the subject and is not an implant, does not support or sustain human life, and is not of substantial importance for diagnosis, curing, mitigating, preventing impairment to human health or treatment of ESRD patient. The risk assessment by the Sponsor concludes that the device poses minimal risk to the subject.*

In Appendix I is a summary of the test validation studies.

6.1.3 INVENTORY AND DISPENSING

Investigator site will store the hearing aids in a locked room and cabinet. Only the designated staff at the investigator site will conduct the randomization and blinding coding and store randomized devices according to the sites working procedure. Only the designated staff is able to retrieve and directly give/ship out to subjects directly the randomized/blinded hearing aids. HCP may not be a designated staff to conduct randomization, blinding coding, storage, shipment or direct retrieval from storage of the devices to the subjects at Visit 3.

6.2 PREPARATION/HANDLING/STORAGE/ACCOUNTABILITY

6.2.1 ACQUISITION AND ACCOUNTABILITY

Sponsor will deliver the hearing aids to the investigation site before the first subject is enrolled in the study.

If for any reason devices need to be returned to the sponsor, investigator site will be provided with handling instructions at the study site initiation visit.

Return of all devices will be picked-up by the sponsor at the close out monitoring visit at the investigation site.

6.2.2 FORMULATION, APPEARANCE, PACKAGING, AND LABELING

6.2.2.1 INVESTIGATIONAL DEVICE: *VIBE SF*

Legal Manufacturer of the *Vibe SF* hearing aids is WSAUD A/S, Nymoellevej 6, DK-3540 Lynge, Denmark. Manufactured for Vibe Hearing, 3033 Campus Dr., Suite W 125, Plymouth, MN 55441

The investigational device will come in a hearing aid case placed in a cardboard box together with a pack of batteries, a cleaning brush, cleaning cloth and click sleeves sizes XS, M and L. The hearing aid case will contain left and right hearing aid with the click sleeve size S attached. See also Figure 3.

The investigational device will be handed out together with the Safety and Maintenance Information, a Quick start guide and a Quick start card.

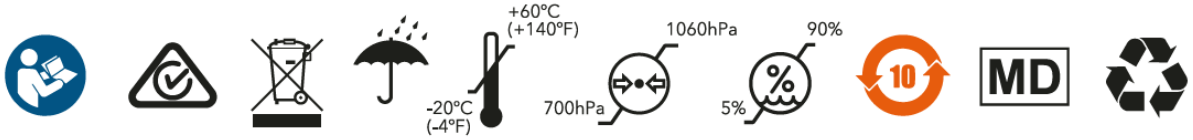
Figure 3. Content enclosed in the *Vibe SF* cardboard box

The Cardboard box will bear the following information:

CAUTION Investigational device. Limited by Federal (or United States) law to investigational use.

Content: Jewel case with 2 hearing aids, silicone click sleeves in 4 sizes (XS, S, M & L), 6 batteries size 10, and cleaning tools.

Warning: For adults 18 years and older with mild to moderate hearing loss. Contact your primary care provider before using this product if you currently experience any of these conditions: (1) Severe hearing loss or deafness in at least one ear. (2) A steep decline in hearing ability within the last 90 days in one or both ears. (3) Active discharge within the last 90 days. (4) Dizziness. (5) A visible deformity of the ear. (6) Pain, or discomfort in the ear, or significant ear wax accumulation.



This NSR device study complies with the abbreviated IDE requirements set forth in (§812.2(b)). Therefore, the *Vibe SF* is labeled in accordance with §812.5.

The labeling of our investigational device does not contain any false or misleading statements nor imply that the device is safe or effective for the purposes being investigated.

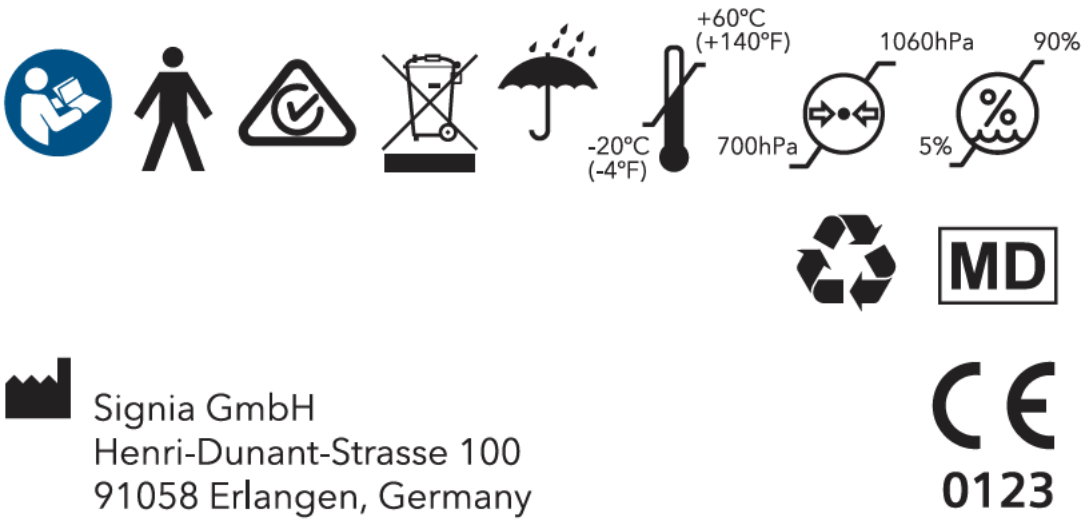
Detailed information on device labeling is in Appendix II.

6.2.2.2 CONTROL DEVICE: SILK 1X

Legal Manufacturer of the Silk 1X hearing aids is Signia GmbH, Henri-Dunant-Strasse 100, 91058 Erlangen, Germany

The control device will come in a standard hearing aid jewel case enclosed in a cardboard box with the following information:

Brand: Signia



The investigational Site will be provided with Click Sleeves Size XS, S, M and L and Batteries in standard packaging to hand out to the participants during standard-of-care fitting at Visit 1 and Visit 2.

6.2.3 PRODUCT STORAGE AND STABILITY

Devices should be stored in their designated jewel cases or appropriate trays or boxes. Temperature for storage should be between 10 to 40 °C (50 to 104 °F). Relative humidity should be 10 to 80% and Atmospheric pressure 700 to 1060 hPa.

6.2.4 PREPARATION

Randomization coding and blinding coding need to be done in advance by the designated investigational site staff. The designated site staff must also set up their inventory so that they are able to track, store, deliver and retrieve the properly randomized and blinded devices designated to the subject at the time of their study visits and when shipping out devices for Field Test 2.

6.3 MEASURES TO MINIMIZE BIAS: RANDOMIZED TREATMENT ORDER AND BLINDING

To avoid order effect of evaluating *Vibe SF* strategy and Silk 1X HCP fit strategy, a balanced randomization list will be generated using approved statistical software. A computer-generated pseudo-random-number list will be used for assigning the treatment order. Assignments will be made either by sealed envelope or provided real-time on the sponsor's electronic database capture (EDC) website on a protected page. New hearing-aid users and experienced hearing-aid users will be distributed evenly in the two randomized groups.

Cross-Over Design: Minimum 12, Maximum 28 subjects
At the final visit (Visit 3), the order of testing the experimental and reference devices will be randomized for the QuickSIN and REM lab tests. Randomization will be handled by a designated person not otherwise involved in the study.

During each of the following performance measures, QuickSIN and REM, at Visit 3 when the subject is using the *Vibe SF* and Silk 1X HCP fit hearing aids, the identity of the *Vibe SF* and Silk 1X will be double blinded to the subject and assessor. An assistant other than the HCP will help secure double blinding during the lab assessments by handling the blinding codes, storing, retrieving and presenting the appropriate hearing aids for evaluation.

During Field Tests 1 and 2 use, blinding is not possible since the option of self-finetuning or finetuning visits to the HCP reveals the device under investigation.

6.4 STUDY INTERVENTION COMPLIANCE

A follow-up call made by investigation site staff to subjects within the first 3 days of their Field Test 1 and Field Test 2 will act as a check that they are wearing their hearing aids and that the EMA data collection is being completed and functioning properly.

7 STUDY INTERVENTION DISCONTINUATION AND SUBJECT DISCONTINUATION/WITHDRAWAL

7.1 DISCONTINUATION OF STUDY INTERVENTION

In case subject discontinues study intervention the hearing aids and other study material given are returned and the subject is out of the study. Organization of returned materials/hearing aids will be handled by the Sponsor in collaboration with site. No further follow up is necessary.

7.2 SUBJECT DISCONTINUATION/WITHDRAWAL FROM THE STUDY

Subjects are free to withdraw from participation in the study at any time upon request.
An investigator may discontinue or withdraw a subject from the study for the following reasons:

- If the subject meets an exclusion criterion (either newly developed or not previously recognized) that precludes further study participation
- Subject is unable to do Field Test 1 and/or 2 under real-life conditions due to quarantine or social distancing due to COVID-19 pandemic.

The reason for subject discontinuation or withdrawal from the study will be recorded on the Study completion Case Report Form (eCRF). Subjects who signed the ICF and are randomized but do not receive the study intervention may be replaced. Subjects who signed the ICF, and are randomized and receive the study intervention, and subsequently withdraw, or are withdrawn or discontinued from the study, will be replaced if the minimum number of 24 subjects has yet to be enrolled.

All data is collected during use of the investigational device. In case a patient is withdrawn from the study there is no further data collection needed, except in the case the patient would report an adverse event which would be seen as at least possible related to the treatment with the device. In this case the patient will be followed up until the event is resolved.

Data collected before withdrawal of consent will be kept in the study.

7.3 LOST TO FOLLOW-UP

A subject will be considered lost to follow-up if he or she fails to return for scheduled visits and is unable to be contacted by the study site staff.
The following actions must be taken if a subject fails to return to the clinic for a required study visit:

- The site will attempt to contact the subject and reschedule the missed visit and counsel the subject on the importance of maintaining the assigned visit schedule and ascertain if the subject wishes to and/or should continue in the study.
- Before a subject is deemed lost to follow-up, the investigator or designee will make every effort to regain contact with the subject (where possible, 3 telephone calls and, if necessary, a certified letter to the subject's last known mailing address or local equivalent methods). These contact attempts should be documented in the subject's medical record or study file.

Should the subject continue to be unreachable, he or she will be considered to have withdrawn from the study with a primary reason of lost to follow-up.

8 STUDY ASSESSMENTS AND PROCEDURES

8.1 EFFECTIVENESS ASSESSMENTS

Data are collected via questionnaires, laboratory speech testing and EMA surveys during field use. An overview is given below in Table 4.

Stage	Intervention	Method

Screening	Otoscopy Tympanometry Audiometry	Otoscope, tympanometer and standard audiometer performed by HCP.
	Hearing in Noise Question	HCP asks subject: Do you have trouble hearing in noise? Y/N
	Self-Perceived Hearing Loss questionnaire	HCP asks subject to describe their hearing loss on a 4-point scale: 1. No Trouble 2. A little trouble 3. A lot of trouble 4. Cannot hear
Visit 1	Questionnaires for primary and secondary endpoints on effectiveness	• APHAB The APHAB inventory yields scores for speech communication in quiet, reverberant, and noisy environments, and also measures aversiveness of loud sounds. • SSQ-12 The SSQ-12 includes the factors speech hearing, spatial hearing, qualities of hearing, and listening effort. ➔ Both completed for unaided condition (irrespective of hearing aid experience)
	Randomized *Vibe SF* or Silk 1X HCP fit hearing aids: Bilateral Hearing Aid fitting	*EasyFit* web application (*Vibe SF* strategy) performed by subject. *Connexx* Fitting Software NAL-NL2, verified with probe-mic REM (Silk 1X HCP fit strategy*)* performed by HCP.
	Fine-tuning	For *Vibe SF* strategy, with fine-tuning dialog on *EasyFit* web application done independently by subject. For Silk 1X HCP fit, fine-tuning with HCP as is standard clinical practice.
Field Test 1	Fine-tuning Situation tuning	For *Vibe SF* strategy, with fine-tuning dialog and situation tuning is performed with the *EasyFit* web application by the subject. For Silk 1X HCP fit strategy, fine-tuning appointment with HCP if necessary due to persistent need for fine-tuning that cannot be resolved with the situation tuning using the Signia App.
	Follow-up to ensure EMA survey data capture	Phone call from investigational staff approximately 3+3 days after visit to ensure that daily EMA surveys are being completed; any questions related to data collection may be answered. Questions regarding the hearing aids may NOT be answered and subject will be reminded to refer to the study information provided to them at Visit 1.
	Sound quality, speech understanding and hearing aid satisfaction ratings for secondary endpoint on effectiveness	Subjects will be asked via their study smartphones to give short ratings of sound quality and speech understanding satisfaction in their current listening situation. This EMA is a methodology involving repeated surveys to collect data describing subjects' current or very recent experiences in their real-life conditions.
Visit 2 (only cross-over design)	Questionnaires for primary and secondary endpoint on effectiveness	• APHAB • SSQ-12 ➔ Both completed Aided (Field Test 1 device) and if necessary, assistance given by HCP

	Field Test 1 *Vibe SF* Strategy or Silk 1X HCP fit hearing aids put in storage	Each subject´s *Vibe SF* or Silk 1X HCP fit hearing aids of the Field Test 1 will be blind coded and stored so that the speech test at the final visit (Visit 3) may be done with the exact settings used during the Field Test 1 (i.e., including fine-tuning).
	Cross Over *Vibe SF* or Silk 1X HCP fit hearing aids: Bilateral Hearing Aid fitting	*EasyFit* web application (*Vibe SF* strategy) performed by subject. Connexx Fitting Software NAL-NL2, verified with probe-mic REM (Silk 1X HCP fit strategy) performed by HCP. (only cross-over design)
	Fine-tuning	For *Vibe SF* strategy, with fine-tuning dialog on *EasyFit* web application done independently by subject. For Silk 1X HCP fit, fine-tuning with HCP as is standard clinical practice. (only cross-over design)
Visit 2 (only parallel-arm design)	Questionnaires for primary and secondary endpoint on effectiveness	• APHAB • SSQ-12 ➔ Both completed Aided (Field Test 1 device) and if necessary, assistance given by HCP
	Speech Test for secondary endpoint on effectiveness	• QuickSIN ➔ Unaided ➔ Aided (Field Test 1 device) A speech test is included to give objective data on speech understanding with the Field Test 1 hearing aids.
	Fitting verification of "final fit"	REM of Field Test 1 device for gain comparison
Washout Period (only cross-over design)	5 day + 2-day period of not wearing any study devices	Upon completing Visit 2, the site will collect the hearing aids fitted at Visit 2, store them and send them out upon completing the 5-day washout period.
Field Test 2 (only cross-over design)	See Field Test 1	See Field Test 1
Visit 3 (only cross-over design)	Questionnaires for primary and secondary endpoint on effectiveness	• APHAB • SSQ12 ➔ Both completed Aided (Field Test 2 device) and if necessary, assistance given by HCP
	Speech Test for secondary endpoint on effectiveness	• QuickSIN ➔ Unaided ➔ Aided (device order randomized and double-blinded) A speech test is included to give objective data on speech understanding with the *Vibe SF* and Silk 1X HCP fit hearing aids. Reasons to do speech testing for all three conditions at the end of the study: 1. Otherwise, not able to do perform double-blinded. 2. The cross-over design minimizes ordering bias effects.

	Fitting verification of "final fit"	REM of both fitting strategies (*Vibe SF*/HCP fit) for gain comparison, device order randomized and double-blinded.
	Fitting Preference	Subjects will be asked to respond to the following question on a 5-point Likert scale: *Based on your listening experiences regarding speech understanding, sound quality and naturalness for both products, if you could keep one pair of these hearing aids, which would you choose?*

Table 4. Overview of test tools utilized

8.1.1 SCREENING

Potential subjects will be recruited locally by outreach at the investigator sites, local advertisements, social media advertisements and professional recruiting service. Initial phone/electronic screening will include the question of whether he/she has trouble hearing in noise. If no, they will be excluded. Those remaining will then be asked to rate on a scale of 1-4 her/his perceived hearing loss (no trouble, a little trouble, a lot of trouble, and cannot hear). Listeners at the two extremes will be excluded.

Listeners with appropriate responses are provided an overview of the study intent (subject information) and invited into the clinic to be assessed for eligibility, according to inclusion and exclusion criteria, as described in Section 5.1 and 5.2.

The session begins with otoscopy, tympanometry and a standard audiometric evaluation consisting of air and bone conduction thresholds for each ear. If it is determined they have mild-to-moderate hearing impairment and fulfil all inclusion criteria they will be given study subject information and asked for their voluntary informed consent to participate in the clinical study.

If at this time a subject is identified with significant asymmetries in hearing, the HCP will refer them to an audiologist and/or ENT for follow-up and subject will be excluded from the study (screen failure).

8.1.2 VISIT 1

Subjects complete two questionnaires concerning unaided hearing[1]: the APHAB and SSQ-12. The subjects can ask questions, and the HCP or assistant reads through the filled-out questionnaires with the subject to make sure everything is understood and filled out appropriately.

[1] Participants that have experience with hearing aids are nonetheless asked to fill out the questionnaires as they would *without* the use of their hearing aids in order to have the same baseline for all participants.

Investigational staff complete the randomization process to determine which pair of study hearing aids the subject will receive.

Hearing aid fitting is conducted in a quiet dedicated hearing aid fitting and counselling room.
The subjects starting with the *Vibe SF* strategy, independently fit their *Vibe SF* hearing aids bilaterally themselves using the *EasyFit* web application on the study smartphone provided to them. They are provided with Vibe SF Safety and Maintenance Information, Quick-Start Guide and a Quick-Start Card. The HCP will not interfere or assist subject in fitting their hearing aids.

For the subjects starting with the HCP fit strategy, an HCP fits the *Silk 1X* hearing aids bilaterally using the *Connexx* fitting software to NAL-NL2 validated prescription target, probe-mic REM and conduct fine-tuning as is standard clinical practice.

All subjects are given a user manual for the hearing aids, along with instructions by the HCP or research assistant on how to use the EMA app and study smartphone. Subjects starting with the *Silk 1X* (HCP fit strategy) will be provided counselling on the use of the Silk 1X hearing aids and Signia App (remote-control smartphone app for situation tuning).

The *EasyFit* web application guides the user through the SF procedure as well as the fine-tuning and volume control functionality. Subjects who start using the Silk 1X HCP fit strategy hearing aids will receive instructional material on how to use the Signia App for situation tuning as per standard of care.

Subjects in both groups are instructed to listen to as many listening environments as possible and enter their sound quality, speech understanding and hearing aid satisfaction ratings when randomly prompted by the clinical study smartphone, and subjects may at any time self-enter a rating. The investigational staff will practice with the subjects until they have observed that the subject is able to successfully enter their sound quality, speech understanding and hearing aid satisfaction EMA ratings without any assistance from the investigational staff.

Subjects are asked to report any ADEs occurring during field use.

8.1.3 FIELD TEST 1

All subjects wear their first pair of study hearing aids for two weeks. Since the investigation is designed as a cross-over design in order to be able to do within-subject comparisons, a two-week period was chosen to allow for acclimatization and fine-tuning but not prolong the field test to an extent where it is likely that subjects would drop out of the study or be less motivated in the second field test.

The EMA rating questions on subject´s sound quality, speech understanding and hearing aid satisfaction is filled out in various listening conditions daily. The EMA consists of a short survey that is triggered randomly four times during the entire day and may also be entered at any time the subject wants to enter a rating.

The EMA survey comprises of four single/multiple choice questions (or three, if the situation does not involve speech) which are:

1. Current situation,
2. Sound quality,

3. Speech understanding,
4. Satisfaction

If the timing is inconvenient (e.g., driving a car), the subject can delay the response to the survey (reminder is given to not delay the response unduly, e.g., for more than 1 hour).

Phone calls (approximately after 3 days +3 days field testing) are scheduled with investigational staff. These calls are intended to ensure that all EMA data collection tools are functioning and subjects are reminded to report any adverse device effects (ADE) occurring during field use. The subject also has the possibility to call/e-mail the investigation staff when needed; however, to mitigate the potential for introducing bias through counselling of the self-fit group, any questions about the *Vibe SF* fitting strategy or how to use the device will not be answered by the investigational staff.

For the subjects who start in the HCP fit strategy group, based on complaints the subjects have about sound quality, the audiologist/HCP is able to invite the subject for an in-person fine-tuning visit and adjust the fitting on their *Silk 1X* as in a real-life HCP fitting (standard clinical care).

Subjects are asked to report any ADEs occurring during field use.

All communication with the HCP and/or investigation staff during the field tests will be documented and saved.

8.1.4 VISIT 2

Subjects return to the clinic after approximately two weeks Field Test 1 use. Subjects complete two questionnaires: the APHAB and the SSQ-12, to reflect their hearing experience aided with the Field Test 1 hearing aids. An HCP or assistant reads through the filled-out questionnaires with the subject to make sure everything is understood and filled out sufficiently.

Subjects are asked to report any ADEs occurring during field use.

Cross-over design:

The Field Test 1 HCP fit strategy subjects now cross over to the *Vibe SF* strategy group. Subjects independently fit their *Vibe SF* hearing aids bilaterally themselves using the *EasyFit* web application on the study smartphone. They are provided with the *Vibe SF* Safety and Maintenance Information, Quick-Start Guide and Quick-Start Card (see Appendix II). The HCP will not interfere or assist the subject with the self-fitting.

The Field Test 1 *Vibe SF* strategy subjects now cross over to HCP fit strategy group. An HCP fits the *Silk 1X* hearing aids bilaterally using the *Connexx* fitting software, to NAL-NL2 validated prescription target, probe-mic REM and conducts fine-tuning as is standard clinical practice.

The hearing aids of the Field Test 1 are stored without altering the settings to be used in the REM and speech tests of the final visit (Visit 3).

Parallel-arm design:

12 subjects: The Field Test 1 Vibe SF strategy subjects now cross over to HCP fit strategy group. An HCP fits the Silk 1X hearing aids bilaterally using the Connexx fitting software, to NAL-NL2 validated prescription target, probe-mic REM and conducts fine-tuning as is standard clinical practice.

The hearing aids of the Field Test 1 are stored without altering the settings to be used in the REM and speech tests of the final visit (Visit 3).

38 subjects: This is their final visit. The subjects will not cross over to the other fitting strategy.

Effectiveness is measured with QuickSIN in an unaided condition and aided with Field Test 1 fit hearing aids in a sound attenuated booth. REM will be conducted on Field Test 1 hearing aids.

8.1.5 WASHOUT PERIOD (ONLY FOR CROSS-OVER DESIGN)

Upon completing Visit 2, the site will collect the hearing aids fitted at Visit 2, store them and send them out to subjects upon completing the 5-day washout period.

8.1.6 FIELD TEST 2 (ONLY FOR CROSS-OVER DESIGN)

Field Test 2 will be conducted the same as stated in 8.1.3. Field Test 1.

8.1.7 VISIT 3 (ONLY FOR CROSS-OVER DESIGN)

At the final session after approximately 4 weeks of total field use with a 5-day washout period after two weeks of field use, each subject returns the hearing aids from their second field use test.

Subjects are asked to report any ADEs occurring during field use.

Subjects again complete two questionnaires: the APHAB and the SSQ-12, reflecting their hearing experience aided with the Field Test 2 hearing aids. An HCP or assistant reads through the filled-out questionnaires with the subject to make sure everything is understood and filled out sufficiently.

Effectiveness is measured with QuickSIN in an unaided condition and aided with the *Vibe SF* and Silk 1X HCP fit hearing aids in a sound attenuated booth. Aided testing will be conducted double-blinded and subject is given their field test 1 and 2 devices (*Vibe SF* and Silk 1X HCP fit hearing aids) in randomized order.

REM will be conducted double-blinded, and the subject is given field test 1 and 2 devices (*Vibe SF* & Silk 1X HCP fit hearing aids) in randomized order.

The subject will be asked to fill out a 5-point Likert scale to respond to the prompt: *Based on your listening experiences regarding speech understanding, sound quality and naturalness for both products, if you could keep one pair of these hearing aids, which pair would you choose: Greatly prefer A, Somewhat Prefer A, No Preference, Somewhat Prefer B, Greatly Prefer B.*

8.2 SAFETY AND OTHER ASSESSMENTS

Stage	Intervention	Method
For the duration of the study	Secondary endpoint on device safety	Subjects are asked repeatedly to report any adverse device effects they experience: • Instruction during first Visit (Visit 1). • At follow-up phone call during first field test. • At Second Visit (Visit 2). • At follow-up phone call during second field test. • At final visit (Visit 3).

8.3 ADVERSE EVENTS AND SERIOUS ADVERSE EVENTS

8.3.1 DEFINITION OF ADVERSE EVENTS (AE)

Adverse event, as defined according to ISO1455, means any untoward medical occurrence, unintended disease or injury, or untoward clinical signs (including abnormal laboratory findings) in subjects, users or other persons, whether or not related to the investigational medical device and whether anticipated or unanticipated.

Note 1: This definition includes events related to the investigational device or comparator.
Note 2: This definition includes events related to the procedures involved.
Note 3: For users or other persons, this definition is restricted to events related to the use of investigational medical devices or comparators.

An Adverse event related to the use of an investigational medical device is called an Adverse Device Effect. This definition includes adverse events resulting from insufficient or inadequate instructions for use, deployment, implantation, installation, or operation, or any malfunction of the investigational medical device. This definition includes any event resulting from use error or from intentional misuse of the investigational medical device. It also includes comparator if comparator is a medical device.

8.3.2 DEFINITION OF SERIOUS ADVERSE EVENTS (SAE)

A Serious Adverse event is an adverse event that led to any of the following:
a) death,
b) serious deterioration in the health of the subject, users, or other persons as defined by one or more of the following:
1) a life-threatening illness or injury, or
2) a permanent impairment of a body structure or body function including chronic disease, or
3) in-patient or prolonged hospitalization, or
4) medical or surgical intervention to prevent life-threatening illness or injury or permanent impairment to a body structure or a body function,
c) fetal distress, fetal death or a congenital abnormality or birth defect including physical or mental impairment
Note: Planned hospitalization for a pre-existing condition, or a procedure required by the study, without serious deterioration in health, is not considered a SAE.

Unanticipated serious adverse device effect (USADE) is a serious adverse device effect which by its nature, incidence, severity or outcome has not been identified in the current risk assessment.
Note: Anticipated serious adverse device effect (ASADE) is an effect which by its nature, incidence, severity or outcome has been identified in the risk assessment.

8.3.3 CLASSIFICATION OF AN ADVERSE EVENT

8.3.3.1 SEVERITY OF EVENT

For adverse events (AEs) the following guidelines will be used to describe severity.

- **Mild** – Events require minimal or no treatment and do not interfere with the subject's daily activities.
- **Moderate** – Events result in a low level of inconvenience or concern with the therapeutic measures. Moderate events may cause some interference with functioning.
- **Severe** – Events interrupt a subject's usual daily activity and may require systemic drug therapy or other treatment. Severe events are usually potentially life-threatening or incapacitating. Of note, the term "severe" does not necessarily equate to "serious".]

8.3.3.2 RELATIONSHIP TO STUDY INTERVENTION

All adverse events (AEs) must have their relationship to study intervention assessed by the clinician who examines and evaluates the subject based on temporal relationship and his/her clinical judgment. The degree of certainty about causality will be graded using the categories below. In a clinical trial, the study product must always be suspect.

- **Related** – The AE is known to occur with the study intervention, there is a reasonable possibility that the study intervention caused the AE, or there is a temporal relationship between the study intervention and event. Reasonable possibility means that there is evidence to suggest a causal relationship between the study intervention and the AE.
- **Not Related** – There is not a reasonable possibility that the administration of the study intervention caused the event, there is no temporal relationship between the study intervention and event onset, or an alternate etiology has been established.

8.3.3.3 EXPECTEDNESS

The Sponsor and the independent Medical Monitor will be responsible for determining whether an adverse event (AE) is expected or unexpected. An AE will be considered unexpected if the nature, severity, or frequency of the event is not consistent with the risk information previously described for the study intervention.

8.3.4 TIME PERIOD AND FREQUENCY FOR EVENT ASSESSMENT AND FOLLOW-UP

The occurrence of an adverse event (AE) or serious adverse event (SAE) may come to the attention of study personnel during study visits and interviews of a study subject presenting for medical care, or upon review by a study monitor.

All AEs, including local and systemic reactions not meeting the criteria for SAEs, will be captured on the appropriate case report form (CRF). Information to be collected includes event description, time of onset, clinician's assessment of severity, relationship to study product (assessed only by those with the training and authority to make a diagnosis), and time of resolution/stabilization of the event. All AEs occurring while on study must be documented appropriately regardless of relationship. All AEs will be followed to adequate resolution.

Any medical condition that is present at the time that the subject is screened will be considered as baseline and not reported as an AE. However, if the study subject's condition deteriorates at any time during the study, it will be recorded as an AE.

Further details can be found in the Study Safety Plan.

8.3.5 ADVERSE EVENT REPORTING

The investigator must record non-serious adverse events and report them to the Sponsor in a timely manner after the investigator first learns of the adverse event. AEs which are non-serious not related to the research procedures does not have to be reported to the IRB but will be reviewed by the Sponsor and the Independent Medical Monitor.
In case however that the event is unexpected **AND** more likely than not related to the research procedures it shall be reported to the IRB within 5 days of Investigator receiving notice of the event, as per IRB local guidelines.

8.3.6 SERIOUS ADVERSE EVENT REPORTING

The study investigator shall report an Unanticipated Adverse Device Effect to the study sponsor and to the reviewing Institutional Review Board (IRB) as soon as possible, but in no event later than 5 working days (as per IRB local guidelines) after the investigator first learns of the effect. The study sponsor is responsible for conducting an evaluation of an unanticipated adverse device effect and shall report the results of such evaluation to the Food and Drug Administration (FDA) within 10 working days after the sponsor first receives notice of the effect. Thereafter, the sponsor shall submit such additional reports concerning the effect as FDA requests.

The sponsor must immediately conduct an evaluation of any unanticipated adverse device effect.
If the sponsor determines that an unanticipated adverse device effect presents an unreasonable risk to subjects, the sponsor must terminate all investigations or parts of the investigations presenting that risk as soon as possible. Termination must occur no later than 5 working days after the sponsor makes this determination and no later than 15 working days after the sponsor first received notice of the effect.
Resumption of Terminated Studies:
For a nonsignificant risk device investigation, a sponsor may not resume a terminated investigation without IRB approval. If the nonsignificant risk study was terminated for unanticipated adverse device effects, the sponsor must also obtain FDA approval.

8.4 UNANTICIPATED PROBLEMS

8.4.1 DEFINITION OF UNANTICIPATED PROBLEMS (UP)

Unanticipated problems are defined as problems involving risks to subjects or others to include, in general, any incident, experience, or outcome that meets **all** of the following criteria:

- Unexpected in terms of nature, severity, or frequency given (a) the research procedures that are described in the clinical investigation plan-related documents, such as the approved research Clinical Investigation Plan and informed consent document; and (b) the characteristics of the subject population being studied;
- Related or possibly related to participation in the research ("possibly related" means there is a reasonable possibility that the incident, experience, or outcome may have been caused by the procedures involved in the research); and
- Suggests that the research places subjects or others at a greater risk of harm (including physical, psychological, economic, or social harm) than was previously known or recognized.

This definition could include an unanticipated adverse device effect, any serious adverse effect (USADE) on health or safety or any life-threatening problem or death caused by, or associated with, a device, if that effect, problem, or death was not previously identified in nature, severity, or degree of incidence in the investigational plan or application (including a supplementary plan or application), or any other unanticipated serious problem associated with a device that relates to the rights, safety, or welfare of subjects (21 CFR 812.3(s)).

8.4.2 UNANTICIPATED PROBLEM REPORTING

An investigator shall submit to the sponsor and to the reviewing Institutional Review Board (IRB) a report of any unanticipated adverse device effect occurring during an investigation as soon as possible, but in no event later than 10 working days after the investigator first learns of the effect (21 CFR 812.150(a)(1)), A sponsor who conducts an evaluation of an unanticipated adverse device effect under 812.46(b) shall report the results of such evaluation to the Food and Drug Administration (FDA) and to all reviewing IRB's and participating investigators within 10 working days after the sponsor first receives notice of the effect. Thereafter the sponsor shall submit such additional reports concerning the effect as FDA requests (21 CFR 812.150(b)(1)).

8.4.3 REPORTING UNANTICIPATED PROBLEMS TO SUBJECTS

In case an unanticipated problem would concern other study subjects they will be contacted by the study investigator.

9 STATISTICAL CONSIDERATIONS

9.1 STATISTICAL HYPOTHESES

9.1.1 PRIMARY

The primary purpose of the *SF* Study is to validate the effectiveness of the *Vibe Air* SF strategy based on the intended use and technological characteristics.

Please refer to Section 3 for more detail about the hypotheses. There are 3 APHAB communication subscales that contribute to the perceived benefit (response condition), and each subscale benefit (EC, BN, RV) must simultaneously demonstrate the non-inferiority of *Vibe SF* strategy to HCP fit strategy. Note that higher means are worse.

- H_o EC(benefit): $\Delta EC(benefit)_{HCP\ fit} - \Delta EC(benefit)_{SF} \geq 26$ vs
  H_a EC(benefit): $\Delta EC(benefit)_{HCP\ fit} - \Delta EC(benefit)_{SF} < 26$

- H_o BN(benefit): $\Delta BN(benefit)_{HCP\ fit} - \Delta BN(benefit)_{SF} \geq 27$ vs
  H_a BN(benefit): $\Delta BN(benefit)_{HCP\ fit} - \Delta BN(benefit)_{SF} < 27$

- H_o RV(benefit): $\Delta RV(benefit)_{HCP\ fit} - \Delta RV(benefit)_{SF} \geq 28$ vs
  H_a RV(benefit): $\Delta RV(benefit)_{HCP\ fit} - \Delta RV(benefit)_{SF} < 28$

These are non-inferiority tests comparing the subject´s perceived hearing aid benefit as measured by the difference in each of the three APHAB communication benefit subscales when the hearing aid is HCP fit compared to when it is *Vibe SF* by the subject. The non-inferiority margin (NIM) depends on the communication benefit subscale, according to Cox (1995), and these are the minimum clinically important differences on each of the three communication benefit subscales.

9.1.2 SECONDARY

The secondary objectives do not include any hypothesis tests. However, they will not be analyzed unless the primary effectiveness hypothesis test passes (i.e., rejects all 3 null hypotheses).

Descriptive statistics will be reported on each endpoint by fitting strategy and overall, according to the list in Section 9.4.1.1. In addition, some endpoints require more detailed description. Additional descriptive statistics that will be reported are listed with the endpoints.

EMA Scores: Descriptive statistics of the scores will be reported by fitting strategy and measurement time for each real-life condition.

QuickSIN Scores: Descriptive statistics of the scores will be reported by fitting strategy and measurement time.

SSQ-12 Scores: Descriptive statistics of the scores will be reported by fitting strategy and measurement time for each subscale.

Gain Selection: Descriptive statistics of the probe-mic REM will be reported by fitting strategy and measurement time.

Fitting Preference: Descriptive statistics of the scores will be reported by fitting strategy and measurement time.

Safety Analyses: It is very unlikely that any device-related adverse events will be reported during this NSR device study. However, those that are reported will be tabulated by severity (mild-moderate-severe), seriousness (serious or non-serious) and relatedness (related, not related).

9.2 SAMPLE SIZE DETERMINATION

The sample size was estimated for the Primary Effectiveness Objective; that is the only objective with a hypothesis test. The sample size of 24 was estimated using Pass 2019 and the following parameters:

Parameter	Value
Difference between HCP fit and *Vibe SF* scores (δ) • EC(benefit) • BN(benefit) • RV(benefit)	• $\delta = \Delta EC(benefit)_{HCP\ fitit} - \Delta EC(benefit)_{SF} = 0$ • $\delta = \Delta BN(benefit)_{HCP\ fitit} - \Delta BN(benefit)_{SF} = 0$ • $\delta = \Delta RV(benefit)_{HCP\ fitit} - \Delta RV(benefit)_{SF} = 0$
SD (σ) of scores within a fitting strategy and for the difference between *Vibe SF* and HCP fit, assuming independence ($\sqrt{(2\sigma^2)}$)* • EC(benefit) • BN(benefit) • RV(benefit)	• $\sigma = 24.3$; $\sigma_{DIFF} = 34.4$ • $\sigma = 25.6$; $\sigma_{DIFF} = 36.1$ • $\sigma = 25.5$; $\sigma_{DIFF} = 36.2$ (Leohler & et al, 2017)
Non-inferiority margins (NIMs) • EC(benefit) • BN(benefit) • RV(benefit)	• EC(benefit) = 26 • BN(benefit) = 27 • RV(benefit) = 28 (Cox & Alexander, 1995)
Power	90% on all 3 tests simultaneously, or 96.5% on each individually ($.965^3 = .90$)
Alpha	5% on all 3 tests simultaneously
Test Type	Paired t-Tests for Non-Inferiority

* The variance of the difference of two means is used, not 4 means, even though this is the difference of differences. The reason is that the baseline value (unaided) from which benefit is measured is the same for the SF period and the HCP fit period. Therefore, the difference of differences reduces to the difference between the aided SF score and aided HCP fit score.

** All 3 tests must simultaneously have $p<.05$

The sample sizes were estimated for each test at 80% and 90% power, as shown in the table below. The NIMs were chosen because each listening condition will be analyzed independently in order to determine if there are significant differences in each specific listening conditions. The largest sample size required for combined 90% power was 23. We will increase this to 24 so that the cross-over periods are balanced. A sufficient number of subjects will be included to allow for a minimum of 24 subjects (anticipate up to 15% drop out rate, 24+4) to successfully complete the study. If the parallel-arm design is used, we will increase this to 25 per arm (50 total subjects); for more details on this, please refer to the section on Planned Interim Analyses: 9.4.6.

These sample size tables are applicable to both the parallel-group design and the cross-over (paired or repeated-measures) design. This is because we had no information with which to estimate the *correlation* among pairs of measures, so we used 0 correlation. This is the same as independent treatment groups, or parallel-arm design. Using the largest sample size of the 3 tests, a cross-over design requires 23 subjects with endpoints and a parallel-arm design requires 23 subjects in each arm. Because we prefer that each order in a cross-over design have the same number of subjects, we increased it to 24. (Then the sample sizes were inflated for losses to follow-up, withdrawals, etc.)

Paired or Unpaired T-Tests for Non-Inferiority							
	Numeric Results ———————————————————————						
	Higher Means are Worse						
	EC Hypotheses: H0: δ ≥ NIM vs. H1: δ < NIM						
				Mean			
			Non-Inferiority	of Paired	Standard		
Power on Tests			Margin	Differences	Deviation		
Combined	Individual	N	NIM	δ1	σ	Alpha	Beta
80%	0.93601	19	26	0	34.4	0.05	0.06399
90%	0.96892	23	26	0	34.4	0.05	0.03108
	RV Hypotheses: H0: δ ≥ NIM vs. H1: δ < NIM						
				Mean			
			Non-Inferiority	of Paired	Standard		
Power on Tests			Margin	Differences	Deviation		
Combined	Individual	N	NIM	δ1	σ	Alpha	Beta
80%	0.93457	18	28	0	36.1	0.05	0.06543
90%	0.96942	22	28	0	36.1	0.05	0.03058
	BN Hypotheses: H0: δ ≥ NIM vs. H1: δ < NIM						
				Mean			
			Non-Inferiority	of Paired	Standard		
Power on Tests			Margin	Differences	Deviation		
Combined	Individual	N	NIM	δ1	σ	Alpha	Beta
80%	0.93063	19	27	0	36.2	0.05	0.06937
90%	0.96555	23	27	0	36.2	0.05	0.03445

9.3 POPULATIONS FOR ANALYSES

The following populations will be used in the analyses of the Primary and Secondary endpoints in this study.

ITT Population: The intent to treat (ITT) population includes all subjects who received at least one hearing aid fitting strategy (*Vibe SF* or HCP fit) to evaluate. This population will be used for the Primary Objective hypothesis test. Missing values will be handled as described in Section 9.1.2.

mITT Population: The modified intent to treat (mITT) population includes all subjects in ITT population who have an endpoint for the analysis in question. The mITT population will be used for the analysis of the Secondary Objectives. No imputation of missing values will be done for these endpoints.

9.4 STATISTICAL ANALYSES

9.4.1 GENERAL APPROACH

Section 9 constitutes the statistical analysis plan (SAP) for this study.

The overall approach to this study is that it is an adaptive design with the adaptation being a change from a cross-over design to a parallel-arm design if the latter is necessary to avoid the interaction effects possible in a cross-over design. The high-level design with adaptation is:

1. The study begins with an intended sample size of 24 (28) subjects in a randomized cross-over design of SF first or HCP fit first. There is a washout period of 5 days intended to mitigate the order effect of the cross-over.
2. After 12 subjects have completed both hearing aid fittings and both Field tests, we will test for the order effect by looking for a significant interaction term in the analysis. (The methods of analysis are described below.)
    a. If there is no interaction effect, then we continue with the cross-over design.
    b. If there IS an interaction effect, then we will add subjects so that we have a minimum of 23 per arm (23+2, to account for drop-outs). (Note that we don't need 24 to balance the groups like we did in the cross-over design.) The new subjects will be randomized to SF or HCP fit for one period only. They don't cross over. Of the 12 existing subjects, we use only their Period 1 data; we ignore their data post cross-over.

NOTE: We will not suspend the trial while we analyze the data from the first 12. We will continue the cross-over study, but if we change to the parallel-arm design, we will ignore the Period 2 data (i.e., Field Test 2 data).

9.4.1.1 DESCRIPTIVE STATISTICS

This section describes the descriptive statistics that will be provided with each analysis. The statistics depend on the type of variable (endpoint) that is analyzed. All secondary objectives involve descriptive analyses only.

Descriptive statistics of subject demographics and baseline hearing status will be tabulated. No comparisons will be made because the same subjects serve as *Vibe SF* strategy and HCP fit strategy subjects in this cross-over study.

The descriptive statistics that will be presented will depend on the data type:

1) Continuous data will be summarized using n, mean, SD, minimum and maximum values.
2) Categorical data will be summarized using frequency and percentage.
3) Time-to-event data will be summarized using percentages at relevant time points, along with effective sample size and the 95% confidence interval.
4) Frequency (count) data will be summarized as a categorical variable if there are 5 or fewer values (see #2), or as a continuous variable if there are more than 5 distinct values (see #1).

9.4.1.2 CONTROL OF TYPE 1 ERROR

All hypothesis tests (of which there is only one compound test in this study, and that is for the Primary Effectiveness Objective) will be conducted at α=0.05. Non-inferiority tests (the type of test in this study) are by nature one-tailed. The Primary hypothesis test will be conducted in 3 parts, as described in Section 9.1.1. To control Type 1 error associated with multiple tests, all 3 tests for the Primary Objective must have a p-value of 0.05 or smaller simultaneously.

Although the Secondary Objectives do not include any hypothesis testing, they will not be analyzed or reported unless the primary hypotheses pass (reject all 3 H_os).

9.4.1.3 IMPUTATION OF MISSING DATA AND SENSITIVITY ANALYSES

All attempts will be made to minimize missing data. However, if any subjects in the ITT population have missing primary endpoints, five (5) multiple imputations will be used for the analyses. This consists of imputing values for each missing value as a set (generating 5-sets), analyzing the results for each set, and then pooling the results. The Primary Effectiveness Endpoint is continuous, so the imputation method will be a multiple linear regression using treatment assignment and baseline characteristics.

A sensitivity analysis of the Primary Effectiveness Endpoint will be conducted as a tipping-point analysis, to examine the impact of missing data. It will only be conducted if the hypothesis test passes (i.e., rejects H_o). We will start by assuming that all missing Primary Effectiveness Endpoints have values indicating the inferiority of *Vibe SF* strategy, and if the Primary Effectiveness Hypothesis is not passed, we will change one missing endpoint to a difference of 0 until the hypothesis passes. This will enable determination of the amount of missing data that would alter the final result on the primary effectiveness endpoint.

If the hypothesis test of the Primary Effectiveness Endpoint does not pass, the hypothesis test will be repeated using only those subjects without major protocol violations, i.e., the mITT population. This test is for SPONSOR´s information only, and will not be used to support the study objective.

9.4.1.4 RANDOMIZATION AND BLINDING

At the time of the visit on which the subject is provided with his/her first hearing aid, he/she will be randomized to either: *Vibe SF* First/HCP fit Second or to HCP fit First/*Vibe SF* Second. A computer-generated pseudo-random-number list will be used for assigning the treatment order. Assignments will be made either by sealed envelope or provided real-time on the sponsor's EDC website on a protected page.

9.4.2 ANALYSIS OF THE PRIMARY EFFECTIVENESS ENDPOINT

The mechanism for validating the *Vibe SF* strategy will be the comparison of subject´s hearing aid benefit as measured by the change from each of the three APHAB communication subscales (EC, BN, RV) benefit score (benefit score = unaided – aided) when the hearing aids are HCP fit compared to when it is *Vibe SF* by the subject.

There are 3 APHAB communication subscales that contribute to the perceived benefit (response condition), and each subscale benefit (EC, BN, RV) must simultaneously demonstrate the non-inferiority of *Vibe SF* strategy to HCP fit strategy. Note that higher means are worse (i.e., higher differences mean that *Vibe SF* strategy performed worse).

- H_o EC(benefit): $\Delta EC(benefit)_{HCP\ fit} - \Delta EC(benefit)_{SF} \geq 26$ vs
  H_a EC(benefit): $\Delta EC(benefit)_{HCP\ fit} - \Delta EC(benefit)_{SF} < 26$
- H_o BN(benefit): $\Delta BN(benefit)_{HCP\ fit} - \Delta BN(benefit)_{SF} \geq 27$ vs
  H_a BN(benefit): $\Delta BN(benefit)_{HCP\ fit} - \Delta BN(benefit)_{SF} < 27$
- H_o RV(benefit): $\Delta RV(benefit)_{HCP\ fit} - \Delta RV(benefit)_{SF} \geq 28$ vs
  H_a RV(benefit): $\Delta RV(benefit)_{HCP\ fit} - \Delta RV(benefit)_{SF} < 28$

These are non-inferiority tests comparing the subject´s perceived hearing aid benefit as measured by the difference in each of the three APHAB communication benefit subscales when the hearing aid is HCP fit compared to when it is *Vibe SF* by the subject. The NIM depends on the communication benefit subscale, according to Cox (1995), and these are the minimum clinically important differences on each of the three communication benefit subscales.

Note that because of the adaptive design which entails possibly moving from a cross-over design to a parallel-arm design, the analysis methods must differ slightly. Section 9.4.2.1 describes the analysis we will use for a cross-over design. Section 9.4.2.2 describes how we will use the cross-over analysis for the interim analysis to determine if we must adapt the design. Section 9.4.2.3 describes the analysis we will use for a parallel-arm design if we change the design.

9.4.2.1 ANALYSIS OF CROSS-OVER DESIGN DATA

This is the final analysis that will be used if the cross-over design is maintained throughout the study.

Each communication benefit subscale will be analyzed using a repeated-measures analysis of variance (rm-ANOVA) in which the repeated (within) factors are order (HCP fit first or *Vibe SF* first) and treatment (HCP fit or *Vibe SF*); there are no between-group factors. The interaction term, order x treatment, will not be included because, if we use this design, it is because we have concluded that the interaction term is not significant. See Section 9.4.2.2.

The hypothesis test for each communication benefit subscale will be conducted as the one-sided upper 95% confidence bound of the regression coefficient on treatment. If this value is less than the NIM for that communication benefit subscale, the null hypothesis will be rejected (at α=0.05, by definition of the confidence bound). ***The p-values for all 3 communication subscales must be 0.05 or smaller in order for the global hypothesis test to pass (reject the global null of inferiority).***

Because Sponsor would like to report a global p-value for these tests, the 3 p-values will be combined into a single value using the weighted harmonic mean (WHM) (Good, 1958) (Wilson, 2019) (Vovk & Wang, 2019):

$$pWHM = \sum w_i / \sum (w_i / p_i) \qquad i=1....L$$

where L=3, the number of order tests being combined into one subscale score. The weights (w_i) are set equal to 0.3333… They are weighted equally because the scores are calculated with each component weighted equally. This method does not require the independence of the tests. Although this method can be anticonservative, it has been shown to be very close to the intended false positive rate when the pWHM is close to 0.05. Since the sample was sized for this p-value, the pWHM should be neither conservative nor anti-conservative.

Descriptive statistics for the treatment groups for each of the three communication benefit subscales, EC(benefit), RV(benefit), BN(benefit), at each time point will also be reported.

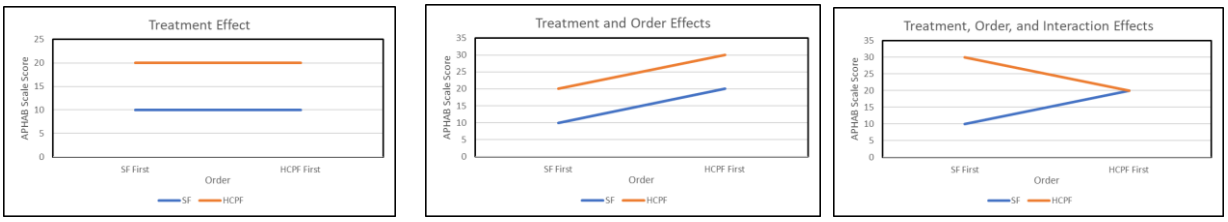
9.4.2.2 INTERIM ANALYSIS OF CROSS-OVER DESIGN FOR DETERMINATION OF DESIGN APPLICATION

An interim analysis will be conducted to determine if the design will be changed from a cross-over to a parallel-arm design. The analysis will be conducted by an independent statistical group so that no information about the effects of fitting (SF vs HCP FIT) will be known to Sponsor. A nuisance parameter will be estimated and tested for significance to decide whether to change the design.

The analysis will be conducted as follows.

Each communication benefit subscale will be analyzed using a repeated-measures analysis of variance (rm-ANOVA) in which the repeated (within) factors are order (HCP fit first or SF first) and treatment (HCP fit or SF); there are no between-group factors. The interaction term, order x treatment, will be included to determine whether it is necessary to change from a cross-over design to a parallel-arm design. This is the nuisance factor that is the crux of the adaptation. The presence of an interaction term means that the difference in benefit (i.e., the treatment effect) differs by order. In this case, we cannot combine the estimate of HCP FIT-first benefit with HCP fit-second, and similarly for SF-first and second. Here is the visual representation of the effects in the following Figures a, b and c:

a) Treatment (TX) Effect b) TX, Order Effects c) TX, Order, Interaction Effects



HCPF = HCP fit

Figure (a) shows an effect of treatment only. The score with SF, averaged over SF First and SF Second, is different from the average score of HCP fit. The scores for SF are the same for both orders, and that is also true for HCP fit, so there is no order effect. The difference between SF and HCP fit is the same for both orders, so there is no interaction effect.

Figure (b) shows an effect of treatment and of order. The average SF score is lower than the average HCP fit score, and the averages are lower when SF is first than when HCP fit is first. However, the difference between SF and HCP fit is the *same regardless of order,* which means there is no interaction effect. So, in spite of the order effect, it is possible *to estimate the difference between treatments* and to *test for the non-inferiority of SF to HCP fit*.

Figure (c) shows an effect of treatment and order, and also an interaction effect. The interaction effect occurs because the difference between treatments is *not* the same with both orders. Compare this to Figure (b), in which the difference *is* the same. In this case, the test for non-inferiority of SF to HCP fit

must be done on SF First and HCP fit First separately because non-inferiority might be true in one case and not in the other.

It is important to note that it is not the order effect, but the interaction effect, that makes it impossible to do a non-inferiority test. The interaction term will be tested be combining the p-values from the 3 scales. The method WHM, show in Section 9.4.2.1, will be used here, but in this case, it will be the interaction term p-values that are combined. The combined p-value will be compared to α=0.10; if the null hypothesis of no interaction is rejected in favor of the hypothesis of an interaction, we will switch to the parallel-arm design.

If the design is switched to parallel-arm, then subjects who have not crossed over will have only one treatment, and subjects who have crossed over will have only their first treatment used in the analysis of the parallel-arm data. See Section 9.4.2.3.

9.4.2.3 ANALYSIS OF PARALLEL-ARM DESIGN DATA

Each communication benefit subscale will be analyzed using a t-test of the benefit with SF (as described previously, the difference between baseline and SF score) versus the benefit with HCP fit (the difference between baseline and HCP fit score). ***The p-values for all 3 communication subscales must be 0.05 or smaller in order for the global hypothesis test to pass (reject the global null of inferiority).***

Because Sponsor would like to report a global p-value for these tests, the 3 p-values will be combined into a single value using the method of WHM as described as in Section 9.4.2.1. The p-values cannot be assumed to be independent because the data are from the same set of subjects, and it is therefore likely that the benefit on the EC score is correlated with the benefit on the RV score, etc.
Descriptive statistics for the treatment groups for each of the three communication benefit subscales, EC(benefit), RV(benefit), BN(benefit), at each time point will also be reported.

9.4.3 ANALYSIS OF THE SECONDARY ENDPOINTS

Descriptive statistics will be reported on each endpoint by fitting strategy and overall, according to the list in Section 9.4.1.1. In addition, some endpoints require more detailed description. Additional descriptive statistics that will be reported are listed with the endpoints.

EMA Scores: Descriptive statistics of the scores will be reported by fitting strategy and measurement time for each real-life condition.

QuickSIN Scores: Descriptive statistics of the scores will be reported by fitting strategy and measurement time.

SSQ-12 Scores: Descriptive statistics of the scores will be reported by fitting strategy and measurement time for each subscale.

Gain Selection: Descriptive statistics of the probe-mic REM will be reported by fitting strategy and measurement time.

Fitting Preference: Descriptive statistics of the scores will be reported by fitting strategy and measurement time.

9.4.4 SAFETY ANALYSES

It is very unlikely that any device-related adverse events (ADEs) will be reported during this NSR device study. However, those that are reported will be tabulated by severity (mild-moderate-severe), seriousness (serious or non-serious) and relatedness (related, not related).

9.4.5 BASELINE DESCRIPTIVE STATISTICS

Descriptive statistics of patient demographics and baseline hearing status will be tabulated. No comparisons will be made because the same subjects serve as *Vibe SF* and HCP fit strategy groups in this cross-over study. The statistics that will be tabulated for each variable are listed by variable type in Section 9.4.1.1.

9.4.6 PLANNED INTERIM ANALYSES

See Section 9.4.2.2. We will conduct an interim analysis using a nuisance parameter to decide if the design of the study will be changed from a cross-over design to a parallel-arm design.

9.4.7 SUB-GROUP ANALYSES

This study does not include any sub-group analyses.

9.4.8 TABULATION OF INDIVIDUAL SUBJECT DATA

Data listings by subject will be provided to regulatory agencies.

10 SUPPORTING DOCUMENTATION AND OPERATIONAL CONSIDERATIONS

10.1 REGULATORY, ETHICAL, AND STUDY OVERSIGHT CONSIDERATIONS

10.1.1 INFORMED CONSENT PROCESS

10.1.1.1 CONSENT/ASSENT AND OTHER INFORMATIONAL DOCUMENTS PROVIDED TO SUBJECTS

The responsible investigator at each site ensures that approval of advertisements used to recruit subjects and of the Patient Information / Informed consent form, from an appropriately constituted IRB, is sought for the clinical investigation. The decision of the IRB concerning the conduct of the clinical investigation will be made in writing to the Sponsor and Investigator before commencement of this clinical investigation. The clinical investigation can only begin once approval has been received. Any additional requirements imposed shall be implemented.

Consent forms, including all items as per ISO1455, describing in detail the study intervention, study procedures, and risks are given to the subject and written documentation of informed consent is required prior to starting intervention/administering study intervention. The following consent materials are submitted with this protocol:

- Patient Information Sheet
- Informed Consent Form

The above listed documents are provided separately.

10.1.1.2 CONSENT PROCEDURES AND DOCUMENTATION

The screening process is described in detail in 8.1.1 Screening.

If it is determined that mild-to-moderate hearing impairment is present and that all inclusion criteria seem to be fulfilled the study subject information will be provided and the subject will be asked for their voluntary informed consent to participate in the clinical study.

Informed consent is a process that is initiated prior to the individual's agreeing to participate in the clinical investigation and continues throughout the individual's clinical investigation participation. Consent forms will be IRB-approved and the subject will be asked to read and review the document.

The investigator will obtain informed consent, as per 21 CFR 50, for each subject. The investigator will explain the research clinical investigation to the subject and answer any questions that may arise. A verbal explanation will be provided in terms suited to the subject's comprehension of the purposes, procedures, and potential risks of the clinical investigation and of their rights as research subjects. Subjects will have the opportunity to carefully review the written consent form and ask questions prior to signing. The subjects should have the opportunity to discuss the clinical investigation with their family or surrogates or think about it prior to agreeing to participate.
The subject must also give their permission for representatives of the Sponsor, auditor and regulatory authorities to review their hospital records for the purposes of source data verification.
The subject will sign the informed consent document prior to any procedures being done specifically for the clinical investigation. Subjects must be informed that participation is voluntary and that they may withdraw from the clinical investigation at any time, without prejudice. A copy of the informed consent document will be given to the subjects for their records. The informed consent process will be conducted and documented in the source document (including the date), and the form signed, before the subject

undergoes any clinical investigation-specific procedures. The rights and welfare of the subjects will be protected by emphasizing to them that the quality of their medical care will not be adversely affected if they decline to participate in this clinical investigation.

10.1.2 STUDY DISCONTINUATION AND CLOSURE

This clinical investigation may be temporarily suspended or prematurely terminated if there is sufficient reasonable cause. Written notification, documenting the reason for clinical investigation suspension or termination, will be provided by the suspending or terminating party to the IRB and regulatory authorities. If the clinical investigation is prematurely terminated or suspended, the Principal Investigator (PI) will promptly inform clinical investigation subjects who will also be informed of changes to clinical investigation visit schedule.

Circumstances that may warrant termination or suspension include, but are not limited to:

- Ethical concerns
- Insufficient subject recruitment
- Alterations in accepted clinical practice that make the continuation of a clinical trial unwise.
- Determination of unexpected, significant, or unacceptable risk to subjects
- Demonstration of efficacy that would warrant stopping
- Insufficient compliance to Clinical Investigation Plan requirements
- Data that are not sufficiently complete and/or evaluable
- Determination that the primary endpoint has been met
- Determination of futility

Clinical investigation may resume once concerns about safety, Clinical Investigation Plan compliance, and data quality are addressed, and satisfy the sponsor, the IRB and the regulatory authorities.

Should termination occur, the procedures will be arranged on an individual basis after review and consultation by both parties. In terminating the clinical investigation, the Sponsor and the Principal investigator will assure that adequate consideration is given to the protection of the subject's interests.

10.1.3 CONFIDENTIALITY AND PRIVACY

Subject confidentiality and privacy is strictly held in trust by the participating investigators, their staff, and the sponsor(s) and their interventions. Therefore, the clinical investigation plan, documentation, data, and all other information generated will be held in strict confidence. No information concerning the clinical investigation or the data will be released to any unauthorized third party without prior written approval of the sponsor.
All research activities will be conducted in as private a setting as possible.

The clinical investigation monitor, other authorized representatives of the sponsor, representatives of the IRB, regulatory agencies or the company supplying the clinical investigation product may inspect all documents and records required to be maintained by the investigator, including but not limited to, medical records (office, clinic, or hospital) and pharmacy records for the subjects in this clinical investigation. The clinical investigation site will permit access to such records.

The clinical investigation subject's contact information will be securely stored at each clinical site for internal use during the clinical investigation. At the end of the clinical investigation, all records will continue to be kept in a secure location for as long a period as dictated by the reviewing IRB, or sponsor requirements.

Clinical investigation subject research data, which is for purposes of statistical analysis and scientific reporting, will be entered in an Electronic Data Capture (EDC) system database. The data entered will not include the subject's contact or identifying information. Rather, individual subjects and their research data will be identified by a unique clinical investigation identification number. The clinical investigation data entry and clinical investigation management systems used will be secured and password protected.

10.1.4 KEY ROLES AND STUDY GOVERNANCE

Principal Investigator	**Independent Medical Monitor**
Name, degree, title	Name, degree, title
Institution Name	Institution Name
Address	Address
Phone Number	Phone Number
Email	Email

Further information in regards to members of the study team roles and responsibilities can be found in the study monitoring plan.

10.1.5 SAFETY OVERSIGHT

Safety oversight will be under the direction of the Independent Medical Monitor. All adverse event reports will be directed to the Sponsor / the Independent Medical Monitor. The Independent Medical Monitor will be responsible for the timely review of all adverse events in order to identify seriousness, severity, causality and expectedness (anticipated vs. unanticipated) of the event to the study device and/or study procedure.

The Independent Medical Monitor will review all adverse events throughout the duration of the study until study completion.

10.1.6 CLINICAL MONITORING

The Sponsor shall secure compliance with the requirements of § 812.46 with respect to monitoring investigations. Clinical site monitoring is conducted to ensure that the rights and well-being of trial subjects are protected, that the reported trial data are accurate, complete, and verifiable, and that the conduct of the trial is in compliance with the currently approved clinical investigation plan/amendment(s), with the ISO 14155 and with any other applicable regulatory requirement(s).

- Monitoring for this study will be performed by delegee.
- Monitoring will be performed on-site as well as remote. After the Site initiation visit, up to 5 monitoring visits are planned during the study. Due to the setup of the study, with an interaction effect assessment after 12 subjects to decide on a final sample size, monitoring will be planned accordingly to make sure that the data needed has been reviewed before assessment. In case of difficulties to perform on-site monitoring, this data can be reviewed centrally / remotely.
- Risk-based monitoring will be used, including targeted data verification of key data variables:
    - Informed consent
    - Adherence to eligibility criteria
    - Device accountability
    - Primary endpoints
    - Safety endpoints
    - In addition to this a random review of certain data will be performed.
- In addition to on-site monitoring, the following alternative monitoring techniques will be used:
    - Centralized monitoring by data manager / clinical monitor
    - Communication with study site staff
- Details of clinical site monitoring are documented in a Clinical Monitoring Plan (CMP). The CMP describes in detail who will conduct the monitoring, at what frequency monitoring will be done, at what level of detail monitoring will be performed, and the distribution of monitoring reports.

10.1.7 QUALITY ASSURANCE AND QUALITY CONTROL

The clinical site will perform internal quality management of clinical investigation conduct, data collection, documentation and completion.
Quality control (QC) procedures will be implemented beginning with the data entry system and data QC checks that will be run on the database will be generated. Any missing data or data anomalies will be communicated to the site(s) for clarification/resolution.
Following written Standard Operating Procedures (SOPs), the monitors will verify that the clinical trial is conducted and data are generated and biological specimens are collected, documented (recorded), and reported in compliance with the clinical investigation plan, ISO 14155, and any other applicable regulatory requirements.

The investigational site will provide direct access to all trial related sites, source data/documents, and reports for the purpose of monitoring and auditing by the sponsor, and inspection by local and regulatory authorities.

Quality control procedures shall ensure that participating investigators maintain the records of each subject's case history and exposure to the device under §812.140(a)(3)(i) and ensure that participating investigators make the following required reports to the sponsor:

- Unanticipated Adverse Device Effects [§812.150(a)(1)]
- Withdrawal of IRB Approval [§812.150(a)(2)]
- Failure to obtain informed consent [§812.150(a)(5)]
- Other reports requested by a reviewing IRB or FDA [§812.150(a)(7)]

As per 21 CRF §812.45, a sponsor who discovers that an investigator is not complying with the signed agreement, the investigational plan, the IDE requirements, any other applicable FDA regulations, or any conditions of approval imposed by the reviewing IRB or FDA must promptly either secure compliance, or discontinue shipments of the device to the investigator and terminate the investigator's participation in the investigation. A sponsor must also require that the investigator dispose of or return the device, unless this action would jeopardize the rights, safety, or welfare of a subject.

The following sponsor records will be maintained in one location and available for FDA inspection [§812.140(b)(4)]:

- the name and intended use of the device;
- the objectives of the investigation;
- a brief explanation of why the device is not a significant risk device;
- the name and address of each investigator;
- the name and address of each IRB;
- a statement of the extent to which the good manufacturing practices (21 CFR 820) will be followed in manufacturing the device.
- any other information required by FDA

The sponsor will maintain records concerning complaints and adverse device effects whether anticipated or not [§812.140(b)(5)].

The sponsor will provide the following reports in a timely manner to FDA, the IRB's, and/or the investigators [§812.150(b) (1) through (3) and (5) through (10)].

- Unanticipated Adverse Device Effects
- Withdrawal of IRB Approval
- Withdrawal of FDA Approval
- Progress Reports
- Recalls and Device Disposition
- Final Report
- Failure to obtain informed consent
- Significant Risk Device Determination
- Other Reports

10.1.8 DATA HANDLING AND RECORD KEEPING

10.1.8.1 DATA COLLECTION AND MANAGEMENT RESPONSIBILITIES

Data collection is the responsibility of the clinical trial staff at the site under the supervision of the site investigator. The investigator is responsible for ensuring the accuracy, completeness, legibility, and timeliness of the data reported.

All source documents should be completed in a neat, legible manner to ensure accurate interpretation of data.

Study visit worksheets / checklists will be provided for use as supporting source document for recording data for each subject enrolled in the study. Data recorded in the electronic case report form (eCRF) derived from source documents should be consistent with the data recorded on the source documents.

An Electronic Data Capture system will be used, created as per clinical investigation requirements. The database will be tested to verify that the design meets the specification. Data validation checks will be designed to be applied consistently across trial data, and all errors that are identified through data validation checks should be corrected with a documentation of the discrepancy resolution.
Clinical data (including adverse events (AEs), and expected adverse reactions data) will be entered into SMARTTRIAL, a 21 CFR Part 11-compliant data capture system provided by the Sponsor. The data system includes password protection and internal quality checks, such as automatic range checks, to identify data that appear inconsistent, incomplete, or inaccurate. Clinical data will be entered directly from the source documents.

Validation of the system will be performed to ensure that data entered map to the correct variable in the system, and that the parameters for the variable correctly store the data.
Further details can be found in the clinical investigation Data Management Plan.

10.1.8.1.1 DATA MANAGEMENT SYSTEM

SMART-TRIAL will be used as the primary Electronic Data Capture tool in this study. SMART-TRIAL is developed and owned by MEDEI ApS (www.medei.dk).
Development, validation, and maintenance of SMART-TRIAL is conducted according to medical device software and quality standards.

The Sponsor will enter a contractual agreement with MEDEI ApS which clarifies how MEDEI ApS complies with regulatory requirements for processing of personal identifiable information according to applicable regulations.
All critical actions performed by users of SMART-TRIAL are logged both in relation to general operations (e.g. user creation/edit) and study specific operations. Audit logging ensures that all operations performed by users can be traced.
Validation of the system will be performed before it is being released.

10.1.8.2 DATA SECURITY, ACCESS AND BACK-UP

All data in SMART-TRIAL is collected, transferred, and stored encrypted in databases, which are hosted on ISO certified servers that are managed by MEDEI ApS within the European Union (Ireland). Backups are performed continuously throughout the day and stored within the same country.

To collect and view data, or access a study in SMART-TRIAL users must create a user account with an associated strong password, which shall be used to authenticate with the system. To perform any security critical actions within the system, a user must be authenticated. SMART-TRIAL implements two-step authentication for every log in, i.e. users must log in to the system using their created credentials and confirm their authentication with a unique one-time code sent to their mobile phone or e-mail address. On successful authentication, SMART-TRIAL creates a unique user-session that is used to identify the authenticated user.

10.1.8.3 ANALYSIS AND ARCHIVING

After a proper quality check and assurance, the final data validation is run. If there are no discrepancies, the Statistical datasets are finalized in consultation with the statistician. Once approval for locking is obtained from all stakeholders, the database is locked and clean data is extracted for statistical analysis. After the database is locked, no modification in the database is possible except in exceptional cases.

An unlocking of the database requires proper documentation and an audit trail has to be maintained with sufficient justification for updating the locked database. Data extraction is done from the final database after locking. This is followed by its archival.

10.1.8.3.1 ELECTRONIC AND CENTRAL DATA VALIDATION

Data validation will be completed on a regular basis. Quality control audits of all key performance and safety data in the database will be made after the sites complete enrolment. The entire database will be re-validated to ensure that there are no outstanding data discrepancies prior to database lock. Any changes to the database after that time will require joint written agreement between Clinical Affairs and Clinical Data Management. Concomitant Medications and Adverse Events entered into the database will be reviewed and assigned the appropriate codes by qualified personnel.

10.1.8.4 STUDY RECORDS RETENTION

The Investigator will be responsible for data handling and record keeping and retention. Data required according to this Clinical Investigation Plan must be recorded on the electronic case report forms (eCRFs) as soon as possible.

If the Investigator relocates, or for any reason withdraws from the clinical investigation, the Sponsor should be prospectively notified. Subjects' hospital files will be archived according to local regulations.

Study documents should be retained for a minimum of 2 years after the date the investigation is completed or terminated or the records are no longer required to support a PMA or PDP, whichever dates is longer. These documents should be retained for a longer period, however, if required by local regulations. No records will be destroyed without the written consent of the sponsor, if applicable. It is the responsibility of the sponsor to inform the investigator when these documents no longer need to be retained.

10.1.9 PROTOCOL DEVIATIONS

A protocol deviation is any noncompliance with the clinical trial protocol and the ISO 14155 requirements. The noncompliance may be either on the part of the subject, the investigator, or the study site staff. As a result of deviations, corrective actions are to be developed by the site and implemented promptly.
An investigator shall notify the sponsor and the reviewing IRB of any deviation from the investigational plan to protect the life or physical well-being of a subject in an emergency. Such notice shall be given as soon as possible, but in no event later than 5 working days after the emergency occurred. Except in such an emergency, prior approval by the sponsor is required for changes in or deviations from a plan, and if these changes or deviations may affect the scientific soundness of the plan or the rights, safety, or welfare of human subjects, FDA and IRB is also required.

It is the responsibility of the site investigator to use continuous vigilance to identify and report deviations. All deviations must be addressed in study source documents, and reported to the Sponsor. Protocol deviations must be sent to the reviewing Institutional Review Board (IRB) per their policies. The site investigator is responsible for knowing and adhering to the reviewing IRB requirements.
Further details about the handling of protocol deviations will be included in the Clinical Monitoring Plan.

10.1.10 CONFLICT OF INTEREST POLICY

The independence of this study from any actual or perceived influence, such as by the medical device industry, is critical. Therefore, any actual conflict of interest of persons who have a role in the design, conduct, analysis, publication, or any aspect of this trial will be disclosed and managed. Furthermore, persons who have a perceived conflict of interest will be required to have such conflicts managed in a way that is appropriate to their participation in the design and conduct of this trial. The study leadership has established policies and procedures for all study group members to disclose all conflicts of interest and will establish a mechanism for the management of all reported dualities of interest.

10.2 ADDITIONAL CONSIDERATIONS

There is currently an outbreak of respiratory disease caused by a novel coronavirus, which may impact the conduct of clinical trials of medical products. Challenges may arise, for example, from quarantines,

site closures, travel limitations, interruptions to the supply chain for the investigational product or other considerations if site personnel or trial subjects become infected with COVID-19. These challenges may lead to difficulties in meeting protocol-specified procedures, including administering or using the investigational product or adhering to protocol-mandated visits and testing, leading to unavoidable protocol deviations.

Ensuring the safety of trial subjects is paramount. It may be necessary to modify the study conduct due to changing circumstances. This may include changes to trial recruitment, continuing use of the investigational product for patients already participating in the trial, and the need to change patient monitoring during the trial. In all cases, it is critical that trial subjects are kept informed of changes to the study and monitoring plans that could impact them.

The Sponsor, in consultation with clinical investigators and Institutional Review Boards (IRBs) may determine that the protection of a subject's safety, welfare, and rights is best served by continuing a study subject in the trial as per the protocol or by discontinuing the administration or use of the investigational product or even participation in the trial.

Due to the fact that the device is a non-significant risk device, with no or very limited expected Adverse Events, no increased risk to safety is expected in the case that the patient cannot come back for a planned follow up visit.

10.3 ABBREVIATIONS

Abbreviation	Word
AE	Adverse Event
APHAB	Abbreviated Profile of Hearing Aid Benefit
AV	APHAB subscale: aversiveness of environmental sounds
BN	APHAB communication subscale: communication in settings with background noise
CFR	Code of Federal Regulations
EC	APHAB communication subscale: ease of communication in favorable conditions
EasyFit	*EasyFit* web application
EMA	Ecological Momentary Assessment
GCP	Good Clinical Practice
HCP	Hearing Care Professional
HCP fit Strategy	Silk 1X Hearing Care Professional Hearing Aid Fitting Strategy
H_a	Alternative hypothesis
H_o	Null hypothesis
ICF	Informed Consent Form
IRB	Institutional Review Board
ISO	International Organization for Standardization
ITT	Intent to Treat population
mITT	Modified intent to treat population
n	Number; sum of subjects
NAL NL2	National Acoustic Laboratories Nonlinear Version 2
NIM	Non-inferiority margin
NSR	Non-Significant Risk
OSPL	Output sound pressure level
QuickSIN	Quick Speech-in-Noise test
REM	Real-ear measures
rmANOVA	Repeated-measures analysis of variance
RV	APHAB communication subscale: communication in reverberant rooms such as classrooms
SAE	Serious Adverse Event
SAP	Statistical analysis plan
SF	Self-Fitting
SF Strategy	Self-Fitting Hearing Aid Fitting Strategy
SOA	Schedule of Activities
SSQ-12	Speech, Spatial and Qualities of Hearing scale

10.4 PROTOCOL AMENDMENT HISTORY

The table below is intended to capture changes of IRB-approved versions of the protocol, including a description of the change and rationale. A Summary of Changes table for the current amendment is located in the Protocol Title Page.

Version	Date	Description of Change	Brief Rationale

11 REFERENCES

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12 APPENDIX I NONSIGNIFICANT RISK DETERMINATION

Nonsignificant Risk Device Study Classification

US FDA Definition

Non-significant risk devices are devices that do not pose a significant risk to the human subjects. Examples include most daily-wear contact lenses and lens solutions, ultrasonic dental scalers, Foley catheters, endoscopes, magnetic resonance imaging devices, and low power lasers for treatment of pain.

A non-significant risk device study requires only IRB approval prior to initiation of a clinical study. Sponsors of studies involving non-significant risk devices are not required to submit an IDE application to the FDA for approval. Submissions for non-significant risk device investigations are made directly to the IRB of each participating institution. Sponsors should present to the reviewing IRB an explanation why the device does not pose a significant risk. If the IRB disagrees and determines that the device poses a significant risk, the sponsor must report this finding to the FDA within five working days [§812.150(b)(9)]. The FDA considers an investigation of a non-significant risk device to have an approved IDE when the IRB concurs with the non-significant risk determination and approves the study.

The sponsor also must comply with the abbreviated IDE requirements under §812.2 (b):

- Labeling - The device must be labeled in accordance with the labeling provisions of the IDE regulations (§812.5) and must bear the statement "CAUTION Investigational Device. Limited by Federal (or United States) law to investigational use.";
- IRB Approval – The sponsor must obtain and maintain Investigational Review Board (IRB) approval throughout the investigation as a non-significant risk device study;
- Informed Consent – The sponsor must assure that investigators obtain and document informed consent from each subject according to 21 CFR 50, Protection of Human Subjects, unless documentation is waived by an IRB in accordance with §56.109(c);
- Monitoring - All investigations must be properly monitored to protect the human subjects and assure compliance with approved protocols (§812.46). Guidance on monitoring investigations can be found in Guideline for the Monitoring of Clinical Investigations.
- Records and Reports - Sponsors are required to maintain specific records and make certain reports as required by the IDE regulations.
- Investigator Records and Reports – The sponsor must assure that participating investigators maintain records and make reports as required (see Responsibilities of Investigators); and
- Prohibitions –Commercialization, promotion, test marketing, misrepresentation of an investigational device, and prolongation of the study are prohibited (§812.7).

Background

The Vibe Air is an investigational self-fitting air conduction hearing aid that is intended to compensate for impaired hearing and incorporates technology, including software, that allows users to program independently their hearing aids. This technology integrates user input with a self-fitting strategy and enables users to independently derive and customize their hearing aid fitting and settings.

Risk Assessment

- Summary of test validation studies

Document No: D00230228 Version 1, Clinical Study Doc – SF System Verification Activities Overview

- SF System

Risk assessment identified risks of over-amplification or misuse of the device, which are mitigated by design and labeling and are below risk acceptability threshold.

Mitigations to prevent over-amplifications include a safety output limiter which is a hardware measure for limiting the OSPL in failure mode. Hence, for the implemented cluster, the safety limiter is 6 dB above maximum OSPL of the specific cluster. Other mitigation measures include performance testing as electroacoustics and software verification and validation. Critical use-related scenarios (critical tasks) and essential functions have been identified and will be tested and validated in Human Factors testing.

The risks associated with the use of the SF system are acceptable when weighted against the expected benefits to the study subjects. The benefit outweighs the overall residual risk.

- **Comparison to Bose Hearing Aid**

Topic	**Bose Hearing Aid (comparator device)**	***Vibe SF* (investigational device)**	**Risk comparison**
Energy source	Li-Ion rechargeable battery	Standard Zinc-Air hearing aid battery, non-rechargeable	Lower risk due to the absence of a charging procedure
Maximum output sound pressure level	115 dB SPL	114 dB SPL	No difference
Frequency bandwidth	200 Hz to 8000 Hz	530 Hz to 8400 Hz	No difference
Acoustic coupling to ear canal	Closed	Open	Lower risk due to larger ventilation opening
Noise reduction	Active noise cancellation (by inverse sound wave)	Noise reduction based on attenuation of the microphone signal	Lower risk due to the absence of high-level cancellation signals
Directionality	Omnidirectional or directional hearing aid modes	User cannot control directionality	Lower risk due to reduced chance of not hearing vehicles, sirens, etc.

The principles of operation, performance and repeatability of the self-fitting feature have been a subject of research for a number of years. In October 2018, Bose was granted its request for De Novo classification of the Bose® Hearing Aid (DEN180026, 2018). FDA classified this type of device as a Class

II, self-fitting air-conduction hearing aid. FDA created a new classification regulation (21 C.F.R. § 874.3325) identifying this device type as a wearable sound amplifying device that is intended to compensate for impaired hearing and incorporates technology, including software, that allows users to program their own hearing aids. This technology integrates user input with a self-fitting strategy and enables users to independently derive and customize their hearing aid fitting and settings.

Comparison of Bose Validation Study vs. *Vibe SF* Validation study depicted in the following table:

Topic	Bose (comparator)	*Vibe SF* (investigational device)	Risk
Study design	2 arm study	Cross-over design	No new risk
Study design	1 month field trial	2x 2 weeks field trial	No new risk, risk less because of scheduled visit after 2 weeks
Experimental device	Prototype Hearing Aid with Earbuds and Neck band	Instant Fit CIC with Click Sleeves	Smaller risk than Bose because *Vibe SF* based on a released hearing aid, SPONSOR has a lot of experience with hearing aids
Fitting device	Smartphone App	Smartphone Web App	For *Vibe SF* risk of loss of internet connection
Basis of First Fit	Start Setting at 0 dB real ear insertion gain, Adjustments with two wheels “Loudness” and “Fine-Tuning” inducing changes in 2 compression bands	Guided Procedure resulting to activation of one of the built-in clusters	Similar risk than Bose, *Vibe SF* clusters are based on audiological expertise, all settings after self-fit are audiologically valid. Loudnesswheel Settings of Bose are also based on typical hearing aid settings
Initial Setting	0 dB real ear insertion gain	Most common Cluster activated	Smaller Risk than Bose because even in the case of failed first-fit, audiologically valid setting active in hearing aid
Self-Fitting procedure	Adapting “Loudness” and “Fine-Tuning” Wheel on Smartphone App	Web-App guided procedure starting with hearing loss profiling and subsequent cluster and master gain selection. Overall loudness can be adapted before completing procedure	Smaller Risk because Hearing profiling gives some indication to hearing condition, warnings are issued of hearing loss is too severe or asymmetrical
Time of Self-Fitting	Over the course of the field-trial	Completed at 1st visit Fine-tuning possible during field-trial	Smaller Risk because subject leaves clinic with the first fit completed, benefits from amplification straight away
Questionnaires	APHAB, SSQ 12	APHAB, SSQ 12	No difference
Speech Test	QuickSin	QuickSin	No difference

Surveys	5 Star Rating and in-the moment blinded comparisons of self-selected settings with those that had been selected by audiologist	EMA Survey on Sound Quality, Speech understanding and Satisfaction	EMA Survey most likely quicker than having to compare two settings and giving a rating. Less disturbing in every-day life
Energy source	Li-Ion rechargeable battery	Standard Zinc-Air hearing aid battery, non-rechargeable	Lower risk due to the absence of a charging procedure
Maximum output sound pressure level	115 dB SPL	114 dB SPL	No difference
Frequency bandwidth	200 Hz to 8000 Hz	530 Hz to 8400 Hz	No difference
Acoustic coupling to ear canal	Closed	Open	Lower risk due to larger ventilation opening
Noise reduction	Active noise cancellation (by inverse sound wave)	Noise reduction based on attenuation of the microphone signal	Lower risk due to the absence of high-level cancellation signals
Directionality	Omnidirectional or directional hearing aid modes	User cannot control directionality	Lower risk due to reduced chance of not hearing vehicles, sirens, etc.

The Bose Validation study reported no adverse events or serious adverse events during its study.

Sources for all Risk information in this study protocol have been derived from the following documents:

- Date Accessed 2021APR26. (Version X). EasyFit system covering hardware and software components (EN). Source of product information: WSAUD A/S: Document No.: D00212131
- Date Accessed 2021APR26. (Version X). Risk analysis for Hearing Instruments, Fitting-Software, Accessories and Smartphone Apps (EN). Source of product information: WSAUD A/S: Document No.: D00013737
- Date Accessed 2021APR26. (Version X). Self-Fitting System Risk Assessment for Clinical Study (EN). Source of product information: WSAUD A/S: Document No.: PENDING

Summary Conclusion

The Vibe Air hearing aid and SF study poses a nonsignificant risk to patients when compared to other US FDA approved SF hearing aid (Bose Hearing Aid) and Bose validation study.

13 APPENDIX II DEVICE LABELING

- Safety and Maintenance Information: Order/Item No.: 10997498 Document No. 00473-99T##-#### ##, Master Rev 05, 04.2021. (D00219154)
- Quick Start Guide: Order/Item No.: 10997511. Document No. 04477-99T##-#### ##, Master Rev 02, 04.2021 (D00219293)
- Quick Start Card: Document No. Order/Item No.: 21006310, Master Rev01, 03.2021 (D00229153)
- Date Accessed 2021APR27. (Version X). SF Study Packaging Image (EN). Source of information: WSAUD A/S: Document No.: D00231203