

# Sensorion



June 2022



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**SENSORION**

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# Investments Highlights

- Sensorion is focused on **innovative treatments** that can **restore, treat and prevent hearing loss**
  - **Two gene therapy programs, OTOF-GT and GJB2-GT**, targeting monogenic forms of deafness:
    - caused by a mutation of the gene encoding for **Otoferlin**
    - related to mutation in **GJB2 gene**
  - **Its oral small molecule asset SENS-401** currently in clinical development in the following indications:
    - Sensorion and **Cochlear Ltd.** CTA approved for SENS-401 in patients scheduled for cochlear implantation in H1 2022 in France. First patient enrolled by mid-2022
    - **Cisplatin-Induced Ototoxicity** clinical PoC study continued with CTA amendment in H2 2022
    - **Sudden Sensorineural Hearing Loss** indication looking for potential partner
- **Exclusive relationship with Institut Pasteur** providing exclusive rights of first negotiation for all patents in the field of the genetics of hearing during the timeframe of the agreement
- Strong partnerships with **Necker Hospital, Cochlear Ltd. and Sonova**
- Strong shareholders support from **leading blue-chip investors**

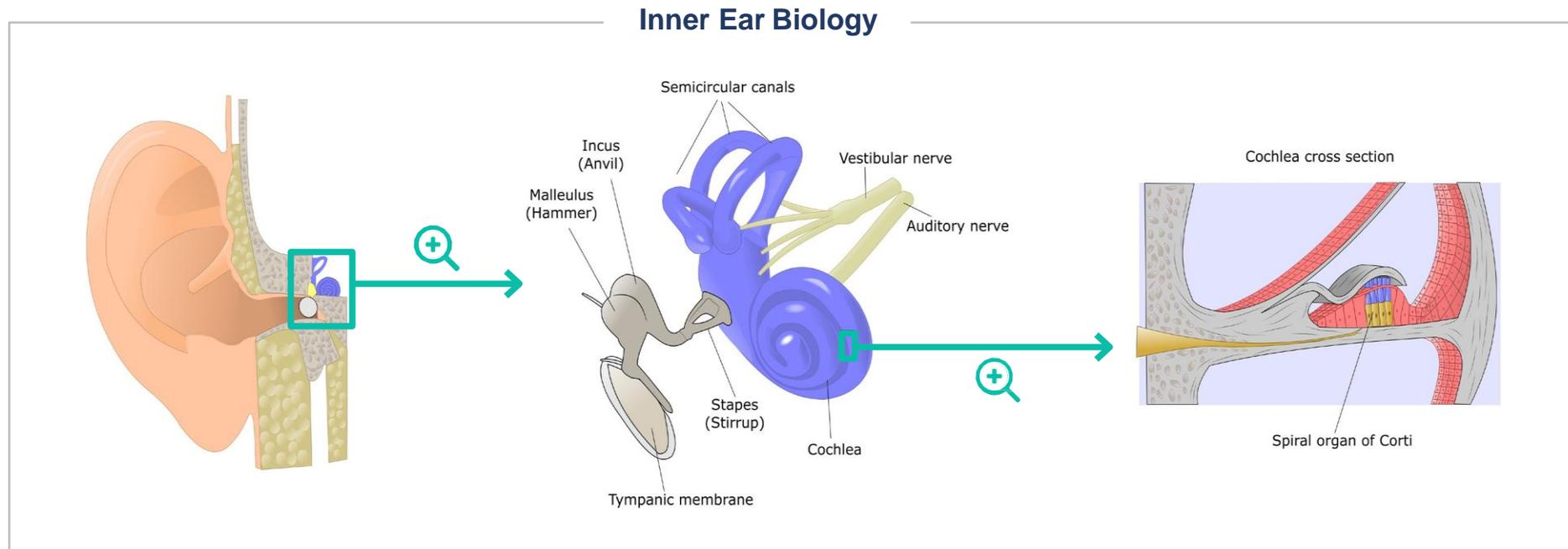


**SOFINNOVA** **bpi**france

## FINANCIAL OVERVIEW

Date Established.....	2009
IPO .....	2015
Euronext Paris .....	ALSEN.PA
Cash (Dec 31, 2021) .....	≈€50m
<i>Cash runway until end of Q2 2023</i>	

# The inner ear: one of the most delicate organs in the human body



## KEY FACTS

### Limited number of hair cells:

- 3,500 Inner Hair Cells
- 12,000 Outer Hair Cells

Hair cells do not naturally regenerate

### According to the WHO\*:

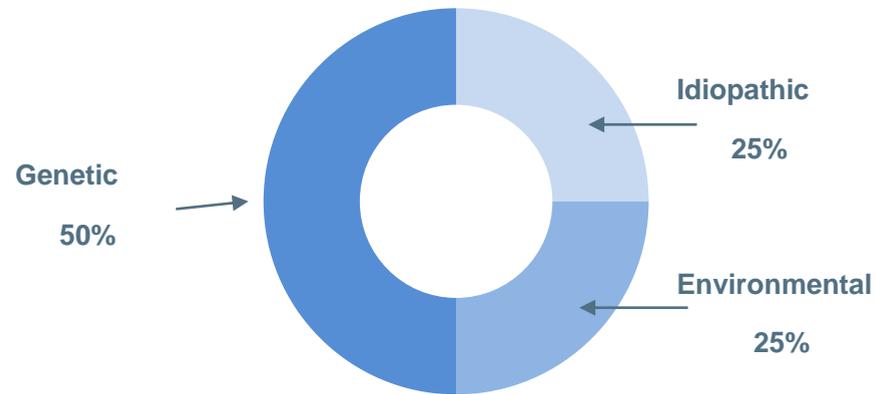
~ 400m people affected by disabling hearing loss worldwide including 34m children

~ 700m people projected to be affected by 2050

*\*World Health Organization, 2021 World report on Hearing*

# Our strategy: **RESTORE**, **TREAT** & **PREVENT** hearing loss

## Causes of hearing loss



### GENE THERAPY APPROACH

- Exclusive collaboration signed with Institut Pasteur in Gene Therapy to **RESTORE** auditory functions
- Program to **RESTORE** hearing in Otoferlin deficiency (DFNB9 deafness), one of the most common forms of congenital deafness
- Program to **RESTORE** hearing in *GJB2*-related hearing loss, the most common form of congenital deafness, also involved in adult early onset forms of severe presbycusis and in childhood onset forms of hearing loss



### SMALL MOLECULE APPROACH

- Phase 2 study completed with SENS-401 to **TREAT** Sudden Sensorineural Hearing Loss – Looking for partnering
- Phase 2a to **PREVENT** residual hearing loss after cochlear implantation
- Phase 2a study with SENS-401 to **PREVENT** Cisplatin-Induced Ototoxicity

# Our critical strategic alliances from bench to bedside



- EU reference center for monogenic forms of deafness
- Natural History study currently running for all monogenic forms of deafness; extension in EU clinical sites in preparation (Otoconex study)



- Interdisciplinary approach to the mechanisms of hearing and its damage
- Research in deafness therapies and preclinical studies

**TRANSLATIONAL RESEARCH**

**CLINICAL RESEARCH**

**SENSORION**



**French Military Biomedical Research Institute**

- Access to a military population at risk of noise-induced hearing loss
- Strong medical network, strict monitoring and precise, regular, well-documented explorations
- Partnership to identify biomarkers for noise-induced hearing loss



**Cochlear™**

- Global leader in implantable hearing solutions
- Currently developing a drug/ device combination to maintain residual hearing after CI surgery

**DIAGNOSIS & PATIENT JOURNEY**

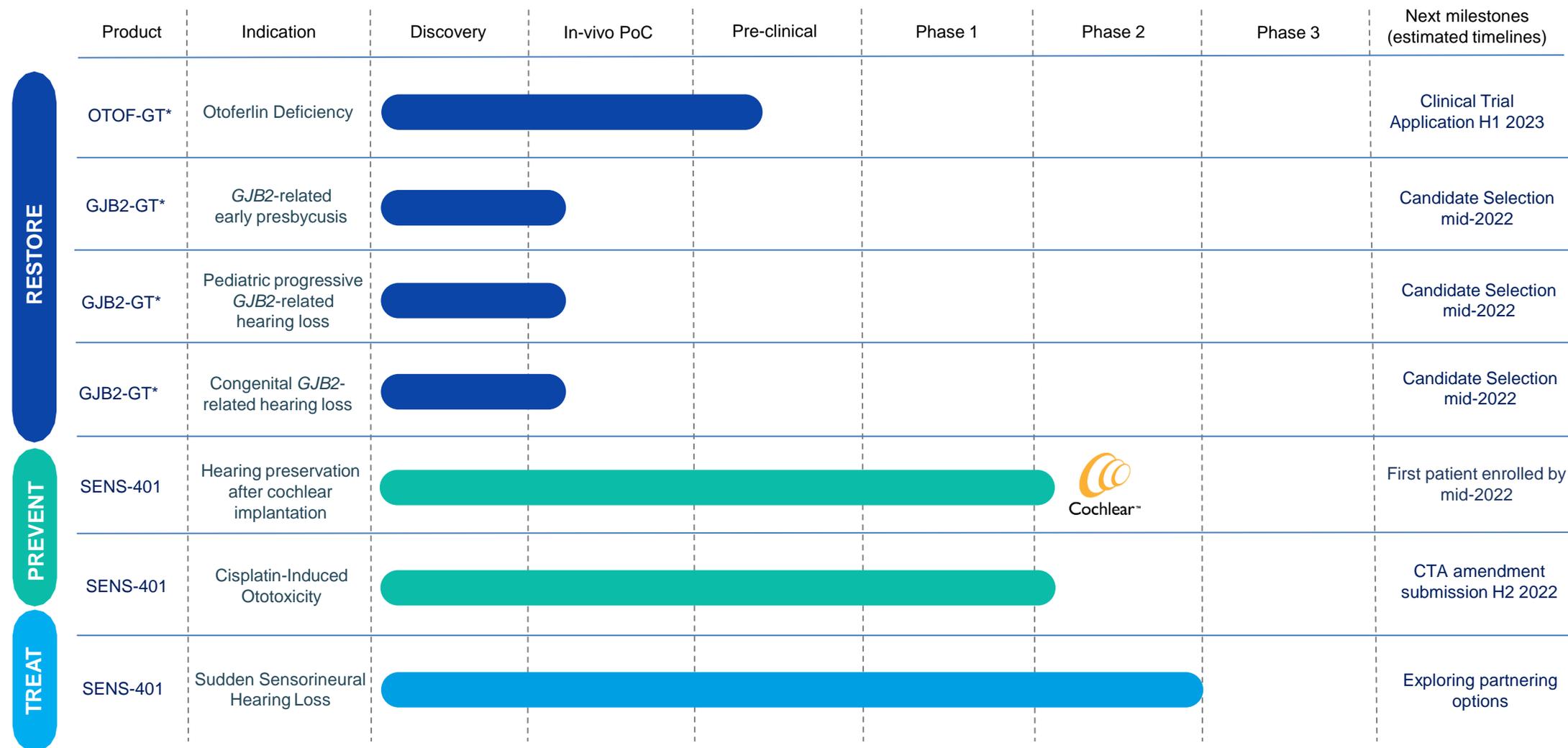


- Biggest retail chains in the world
- A significant shareholder in Sensorion
- Collaboration to initiate Natural History in presbycusis



- Functional exploration in the field of otolaryngology and neurosciences (combining biological and audiological data)

# Our pipeline: a comprehensive portfolio to RESTORE, TREAT & PREVENT hearing loss



*3SBio has a right of first refusal with respect to licensing in Greater China of SENS-401 (except in combination with cochlear implants) and OTOF-GT*

*\*Option to obtain a licence from Institut Pasteur (pre-defined financial terms and other terms to be negotiated)*

# An experienced team, Board of Directors and SAB



**NAWAL OUZREN**  
Chief Executive Officer

**SENSORION**  
(Since 2017)

**SHIRE**  
(2016-2017)  
Head of the Global Genetic Diseases Franchise



**GÉRALDINE HONNET**  
Chief Medical Officer

**SENSORION**  
(Since 2020)

**GENETHON**  
(2011-2020)  
Director of Development



**NORA YANG**  
Chief Scientific Officer

**SENSORION**  
(Since 2021)

**STRATIFY**  
(2020-2021)  
Cofounder and CSO



**OTMANE BOUSSIF**  
Chief Technical Officer

**SENSORION**  
(Since 2021)

**NOVARTIS**  
(Since 2015)  
Head Cell & Gene Therapy T. Dev.



**STEPHANIE FILIPE**  
Head of PMO

**SENSORION**  
(Since 2020)

**CELLECTIS**  
(2016-2020)  
Program Leader & Preclinical Manager

## Board of Directors

- **Scott D. Myers**, USA, Chairman, Independent Director
- **Khalil Barrage**, USA, Director representing Invus
- **Julien Miara**, France, Director representing Invus
- **Cédric Moreau**, France, Director representing Sofinnova Partners
- **John Furey**, USA, Independent Director
- **Eric de la Fortelle**, France, Independent Director
- **Aniz Girach**, UK, Independent Director
- **Jean-François Morin**, France, Director representing BPI Investment

## Scientific Advisory Board

- **Pr Christine Petit**, France, Chair, Professor, Institut Pasteur
- **Pr Alain Fischer**, France, Professor, Collège de France
- **Dr. Robert Dow**, UK, Chief Medical Officer, Scendea
- **Dr. Paul Avan**, France, Head of the Center for Research, Hearing Institute (Paris)
- **Dr. Diane Lazard**, France, Principal Associate Investigator, Hearing Institute (Paris)
- **Dr. Hernán López-Schier**, Germany, Senior Group Leader & Research Unit Director at the Helmholtz Center (Munich)

# We have established internal capabilities to ensure successful execution



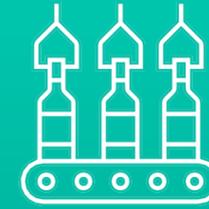
## PRECLINICAL CAPABILITIES FOR SMALL MOLECULES & GT PROGRAMS

- **In Vitro platform:** assays development, target & drug discovery, biomarkers
- **In Vivo platform:** from the PoC to the dose-finding studies in disease-relevant rodent models
- **AAV screening platform:** design and select the best drug candidate (capsid & promoter selection)



## CLINICAL EXPERIENCE

- 400 people enrolled in Sensorion led clinical trials
- Set-up audio tests in different countries, languages
- Central reading of audiometry testing



## CMC GENE THERAPY FACILITIES

- **Process development lab:** non-GMP manufacturing at small scale: set-up a platform for AAV productions
- **Analytical development lab:** development of product-specific analytical methods, internalize generic assays to support process development and AAV productions



## REGULATORY EXPERTISE

- Multiple regulatory interactions with the EMA and the FDA
- Informative discussions about how to shape the treatment guidelines and standardize clinical endpoints



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**GENE  
THERAPY  
RESTORE**

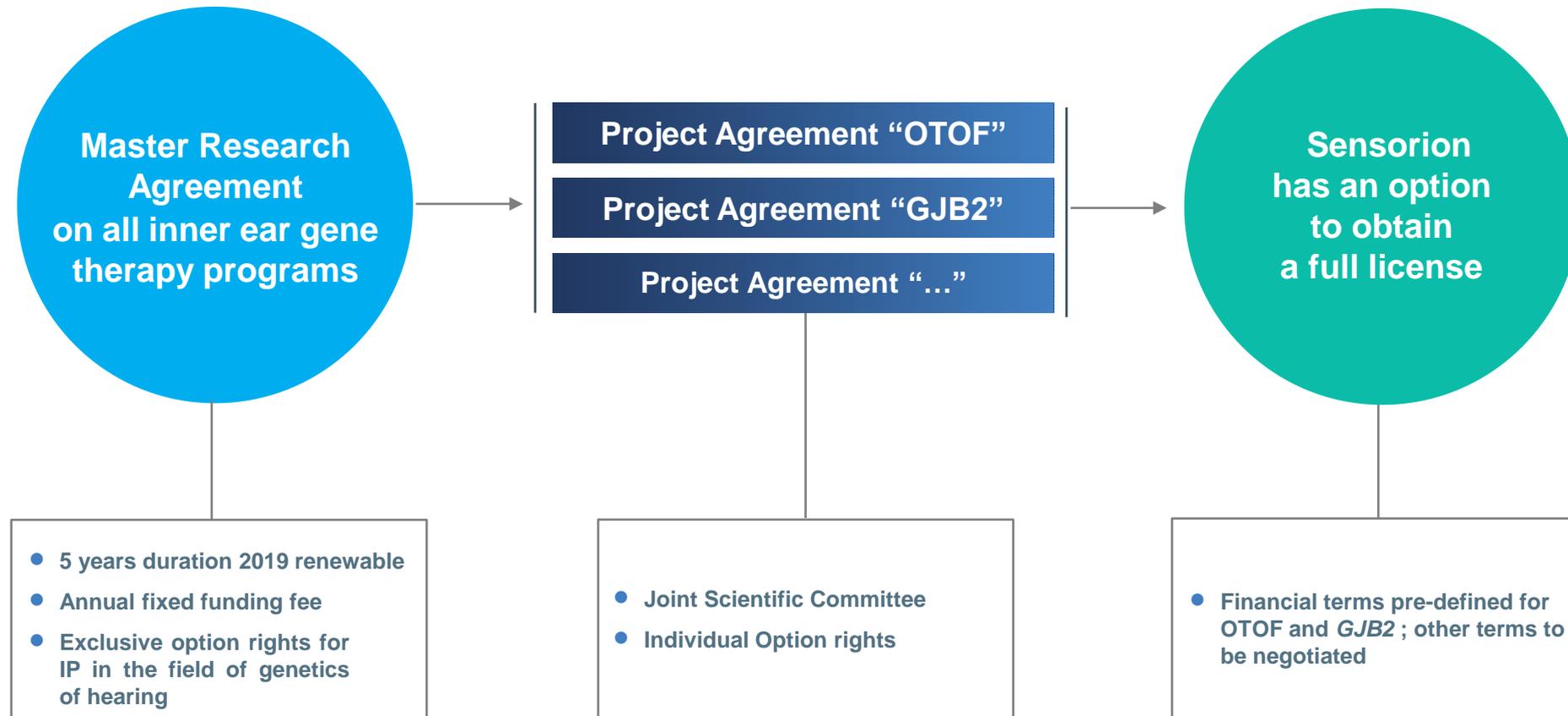
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# Strategic R&D collaboration with Institut Pasteur on genetics of hearing

## 2 PROGRAMS INITIATED UNDER THE COLLABORATION AGREEMENT WITH INSTITUT PASTEUR

Rare disease, high unmet medical need



# Sensorion's gene therapy programs to treat rare auditory diseases

## 2 PROGRAMS INITIATED UNDER THE STRATEGIC COLLABORATION AGREEMENT WITH INSTITUT PASTEUR

### OTOFERLIN DEFICIENCY

- Patients with mutations in OTOF suffer from severe to profound sensorineural prelingual non-syndromic hearing loss
- Otoferlin deficiency could be responsible for up to 8% of all cases of congenital hearing loss
- Prevalence ~20,000 in the USA + EU
- Incidence ~1100 per year in USA + EU

### GJB2-RELATED HEARING LOSS

We have identified three forms of hearing loss associated with *GJB2* gene mutations:

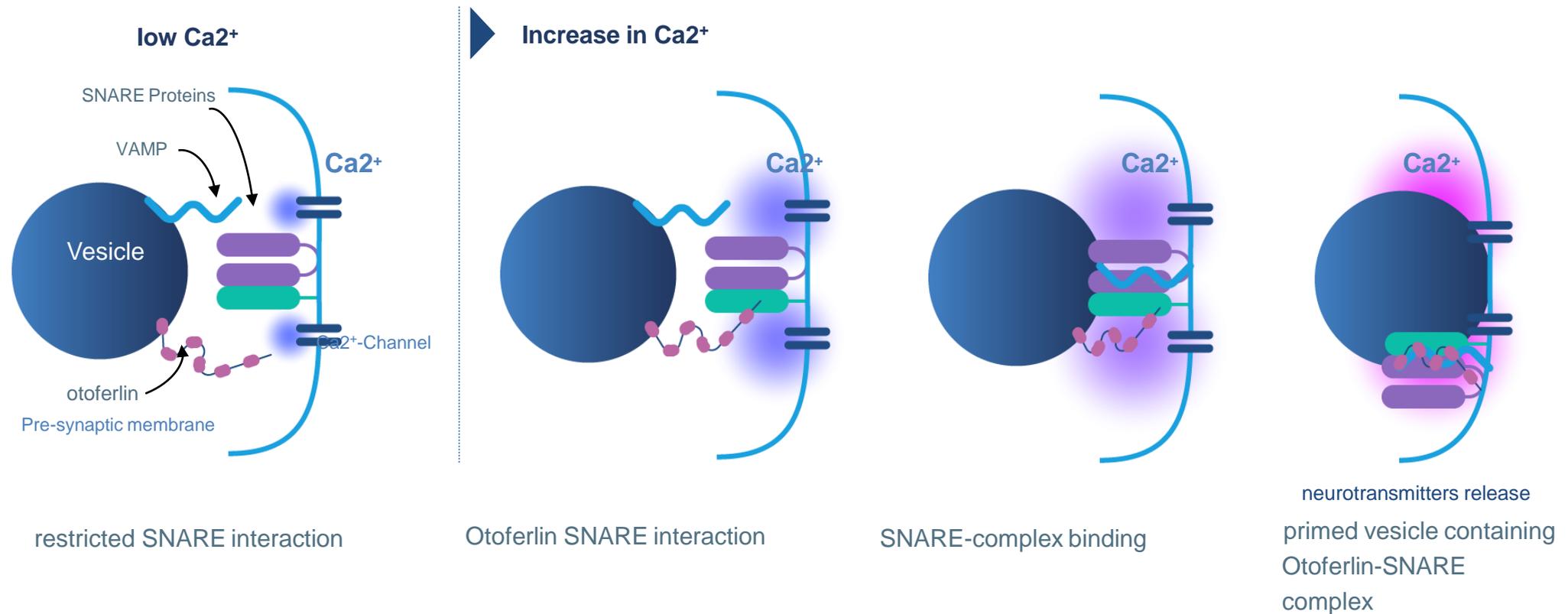
- Early onset of severe presbycusis
- Childhood onset
- Congenital onset
- ~100,000 patients between 30 and 69 years old thought to be affected by a monogenic form of presbycusis due to *GJB2* mutations
- Prevalence of congenital and childhood onset forms are estimated to be around 200,000 patients as around 50% of autosomal recessive non syndromic hearing loss cases are thought to be from *GJB2* mutations

Sources: Akil et al. 2019 ([link](#)), Orphanet ([link](#)), NIH ([link](#)), company estimates based on publicly available population data, Chardan 2020 report, Bryan, Garnier & Co 2019 report, Institut Pasteur, Boucher et al. 2020 ([link](#))

**DELAYED DIAGNOSIS – NOT SUSPECTED AT FIRST SIGHT**

**GENE THERAPY HAS A LIFE-CHANGING POTENTIAL FOR THESE AUDITORY DISEASES**

# OTOF Gene encodes Otoferlin, a key $\text{Ca}^{2+}$ sensor protein

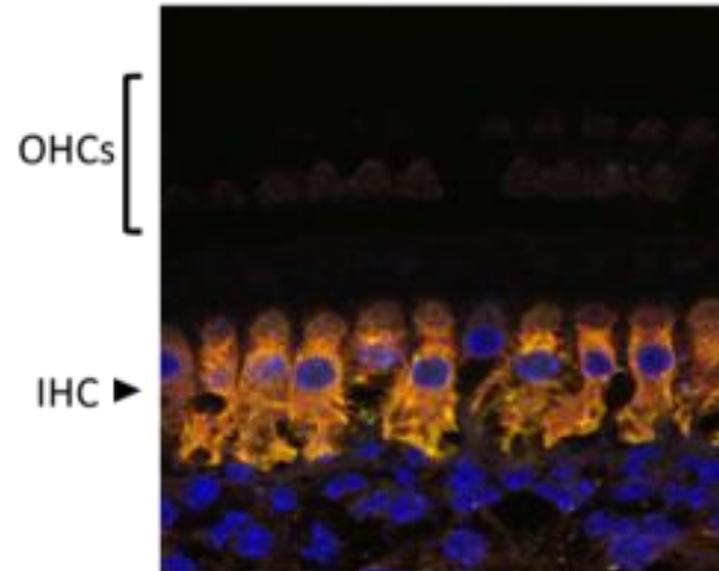


Model illustrating calcium regulation of Otoferlin/SNARE interaction in the hair cell – Adapted from Ramakrishnan *et al.* 2014

**OTOF is the gene coding for the Otoferlin protein, a  $\text{Ca}^{2+}$  sensor for vesicle fusion and vesicle pool replenishment at auditory hair cell ribbon synapses**

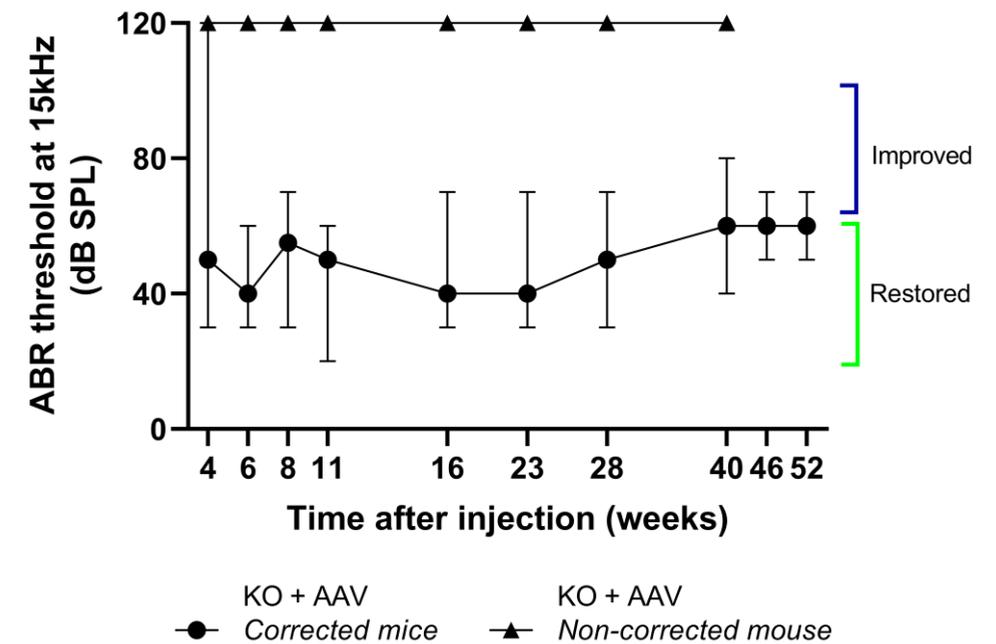
# Dual AAV-OTOF resulted in IHCs specific expression and hearing restoration in DFNB9 mice

## Target cell specific protein expression



- Dual AAV-OTOF injection into the cochlea leads to **IHC specific de novo Otoferlin protein expression**

## Hearing restoration in DFNB9 mice

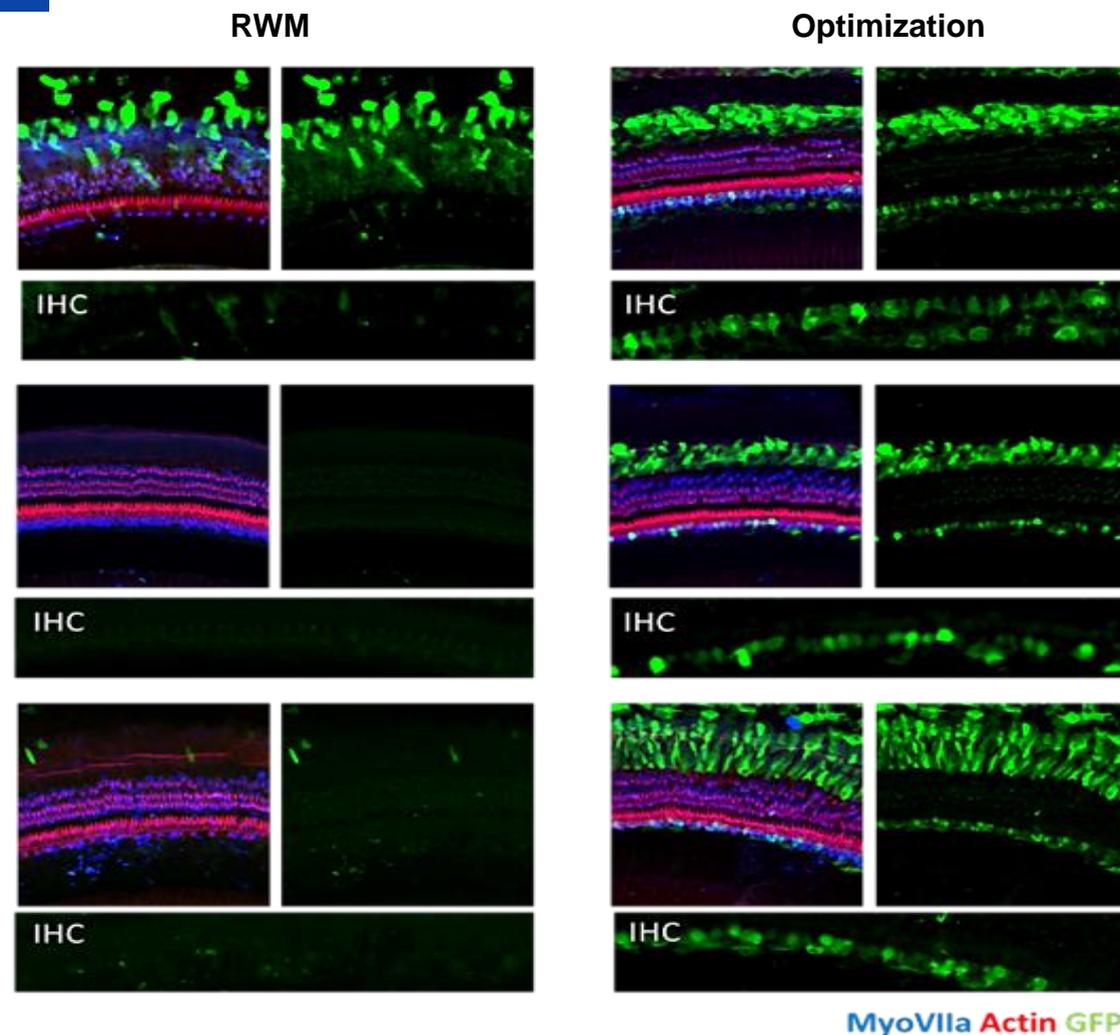


- **Durable hearing restoration** in *Otof*<sup>-/-</sup> mice by dual AAV-OTOF directly delivered to the inner ear up to one year post-injection

# Optimized surgical procedure leads to IHC specific AAV-delivered transgene transduction in mature NHP cochlea

## AAV vector distribution in cochlea of NHP

- Delivery of the AAV transgenes to **IHCs and not OHCs** in NHP
- **High transduction efficiency** with more than 50% IHCs along the tonotopic axis in mature NHP cochlea
- **No correlation** between anti-AAV neutralizing antibodies (measured in blood before injection) and the average of GFP<sup>+</sup> cells



## Surgical approach

- Surgical procedure is **similar to cochlear implantation** and well mastered by ENTs surgeons
- Optimized surgery uses **stapedotomy procedure** to maximize target cells exposure along the full length of the tonotopic axis
- **New injection system** device under development

# Otoferlin “Audinnove” consortium provides privileged access to patients and surgeons

## Audinnove consortium received Hospital-University Research (RHU) prize:

- The consortium is eligible to receive up to €9.7m to develop a gene therapy program addressing Otoferlin deficiency
- Audioferlin: Natural History Study: clinical evaluation and selection of patients
- Database compilation with genotypic and phenotypic characterization of children with congenital hearing loss
- Phase 1/2 gene therapy study (financing up to 1st patient in the clinical study)

**Audinnove consortium is key to the understanding of the epidemiology and to build awareness of the emerging gene therapies**

## Necker-Enfants Malades Hospital

- The first dedicated pediatric hospital in the world

**The Reference Center for Genetic Deafness at Necker coordinates the French and European genetic deafness networks**



Audinnove is financed by the French State, via the National Research Agency through the “Investing for the future” program (ref: ANR-18-RHUS-0007)

## OTOCONEX: expanding the Natural History study across Europe

## AUDINNOVE CONSORTIUM MEMBERS



# OTOF gene therapy program status

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PoC data in mouse & PoC preliminary data in NHPs



Submission of European Natural History Study OTOCONEX



Product development and manufacturing agreement



Production of toxicological batches mid-2022

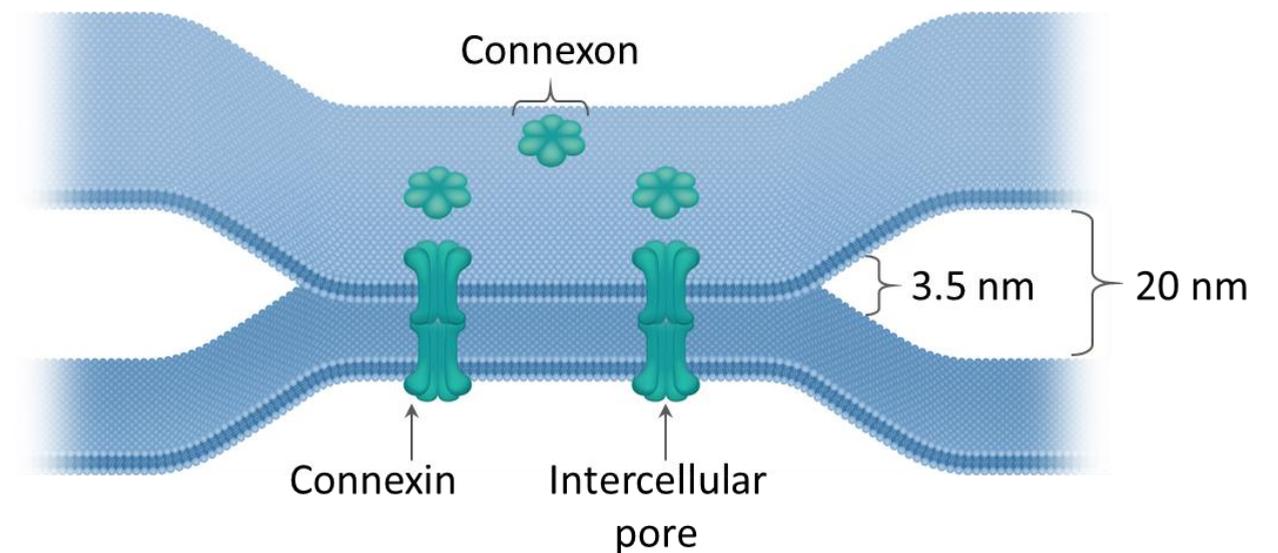
Advice from regulatory authorities



Clinical Trial Application H1 2023

# CONNEXIN 26: a gap-junction protein encoded by *GJB2* gene and responsible for tissue homeostasis mutations in the gene leads to deafness

- *GJB2* is the gene encoding for the **Connexin 26** protein; one of 20 known connexins in humans and almost endemic to the cochlea (together with Cx30); **a hexamer of 6 proteins forms Gap Junctions**
- Gap Junctions are **key for the intercellular exchange of molecules** (miRNA, glucose, ions, etc.) hence responsible for **tissue homeostasis**
- *GJB2* cDNA = 681 bp compatible with the use of a **single AAV**
- More than 100 recessive mutations origin Cx26 truncation / deletion leading to non-syndromic hearing loss and deafness
- *GJB2* mutations are the **most prevalent form of congenital deafness** (DFNB1)
- Children are usually **diagnosed during routine newborn screening** and current SoC is cochlear implantation prior to language acquisition
- Prof. Christine Petit observed in an epidemiology study that some patients demonstrating early onset of **severe presbycusis** carried *GJB2* mutations<sup>[1]</sup>



*Schematic representation of a gap junction – adapted from Kemperman, Hoefsloot and Cremers J R Soc Med 2002;95; 171-177*

[1]: Boucher et al. 2020

## GJB2 gene therapy program next steps

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Submission of European Natural  
History Study OTOCONEX



Submission of Natural History Study  
in collaboration with Sonova

Candidate selection mid-2022

Preclinical IND enabling studies



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**SENS-401**

**TREAT  
AND  
PREVENT**

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# SENS-401: Multiple indications to treat and prevent hearing loss

	Product	Indication	Discovery	<i>In vivo</i> POC	Preclinical	Phase 1	Phase 2	Phase 3	
PREVENT	SENS-401	Hearing preservation after cochlear implantation							
	SENS-401	Cisplatin Induced Ototoxicity							
TREAT	SENS-401	Sudden Sensorineural Hearing Loss*							

*\*Patriot\* Consortium (IRBA, Sensorion, Echodia, Institut Pasteur) awarded up to €10.8m non dilutive financing by French government, staged over the duration of the project. Sensorion will receive up to €5.6m to further develop SENS-401 in SSNHL French army*

# Sudden Sensorineural Hearing Loss SSNHL

## WHAT IS SSNHL?

**The sudden onset of a significant hearing loss due to dysfunction of the cells of the cochlea and central auditory structures.**

Hearing loss develops over less than 72 hrs, hearing sensitivity is reduced by at least 30 dB (1.000 fold) in the affected ear(s).

>70% of cases are idiopathic, known causes include noise/head trauma, ischemia, infection.

>50% of patients suffer from permanent disabling hearing loss, mostly those with initial severe/profound hearing loss.

**Complications significantly impact quality of life due to:**

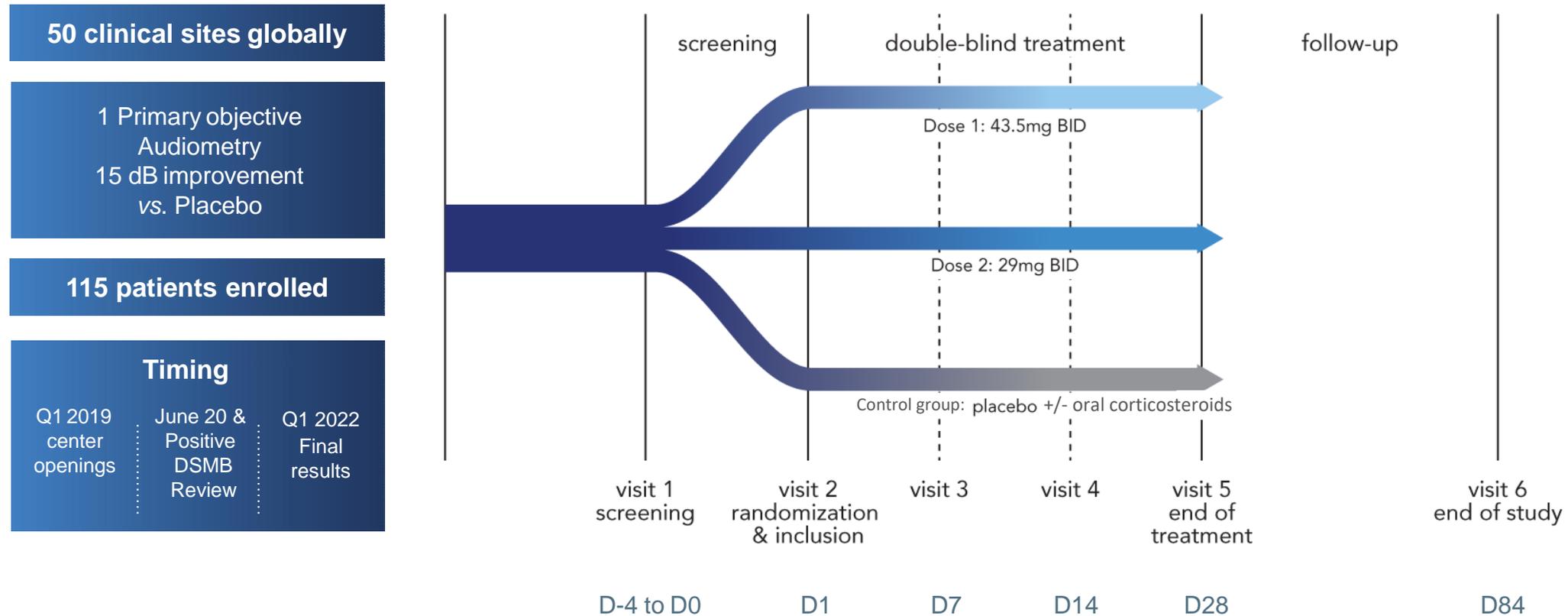
- Difficulties in communicating, social isolation, cognitive decline
- Accompanying tinnitus

**Incidence:** 27-35 per 100,000 (218,000 patients in 2017 in G7 countries)<sup>1</sup>

<sup>1</sup> Company/ estimates based on publicly available data (in the US, Japan, Germany, France, the UK, Italy and Spain)

# SENS-401 SSNHL program: phase 2 design

A RANDOMIZED, MULTICENTER, DOUBLE-BLIND, PLACEBO-CONTROLLED TRIAL

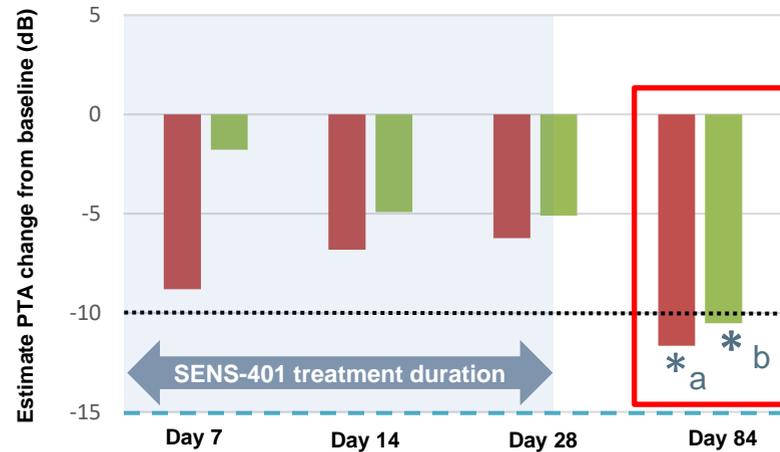


**Primary endpoint definition:**

“...change in pure tone audiometry (PTA); average of the hearing threshold of 3 contiguous most affected hearing frequencies in decibels in the affected ear from baseline to the end of treatment visit (Visit 5/D28±3)”

# SENS-401 shows a clinically meaningful effect at Day 84 in a large sub-population

## PTA improvement from baseline compared to placebo on per protocol idiopathic SSNHL



	Day 7	Day 14	Day 28	Day 84
High dose	N= 21	N= 23	N= 22	N= 17
Low dose	N= 26	N= 26	N= 26	N= 21
Placebo	N= 25	N= 28	N= 27	N= 25

### Primary analysis

Comparing SENS-401 treatment groups to Placebo at Day 28 with a target of an improvement of 15 dB

..... 10 dB change from baseline considered as clinically meaningful

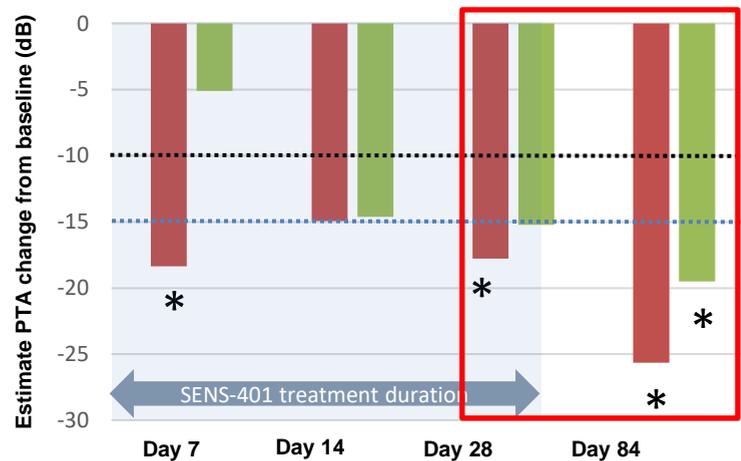
### Sub-population

Homogeneous idiopathic population of patients treated with corticosteroids

- Statistically significant effect on PTA change with more than 10 dB change from baseline vs placebo observed over time in homogeneous idiopathic population of patients treated with corticosteroids

# SENS-401 effect is more pronounced in a profound hearing loss sub-group (PTA $\geq$ 80 dB)

## PTA improvement from baseline compared to placebo



### Legend

■ SENS-401 High dose vs Placebo

■ SENS-401 Low dose vs Placebo

\*  $p < 0,05$

	Day 7	Day 14	Day 28	Day 84
High dose	N= 11	N= 11	N= 9	N= 9
Low dose	N= 11	N= 11	N= 9	N= 9
Placebo	N= 14	N= 15	N= 15	N= 13

### --- Primary analysis

Comparing SENS-401 treatment groups to Placebo at Day 28 with a **target of an improvement of 15 dB**

..... 10 dB change from baseline considered as clinically meaningful

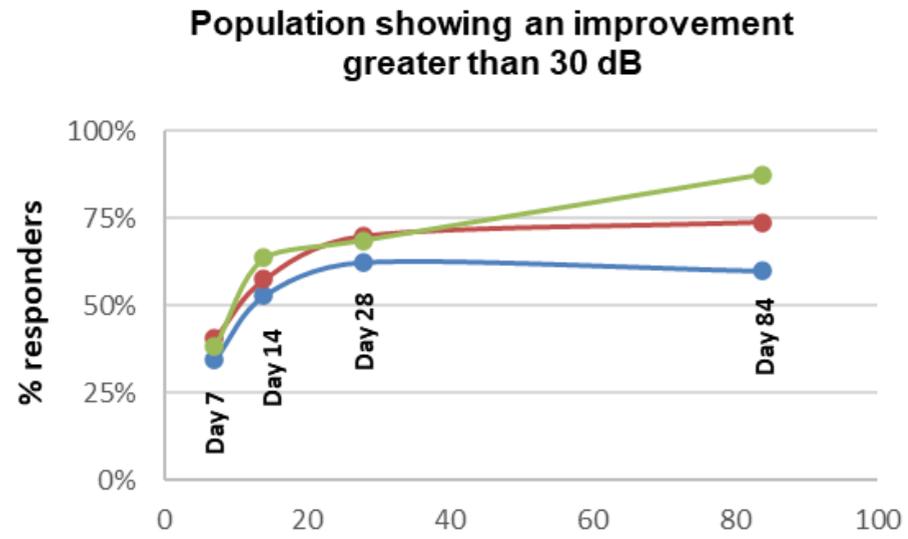
### Sub-population

Homogeneous idiopathic population of patients with profound hearing loss (PTA  $\geq$  80 dB) treated with corticosteroids

- SENS-401 induces a **significant PTA change of at least 19 dB at day 28 and up to 25 dB at Day 84** allowing a reduction of the hearing loss degree **from profound to mild hearing loss**
- A better response was observed in both treatment groups with a **continuous improvement between Day 28 and Day 84**

# Responder rate is always better in the treated groups compared to placebo

## Responder analysis on ITT population



### Legend

- SENS-401 High dose
- SENS-401 Low dose
- Placebo

- Responder rate is **always better** in the treated groups compared to placebo
- Difference between treated groups and placebo **increases over time**

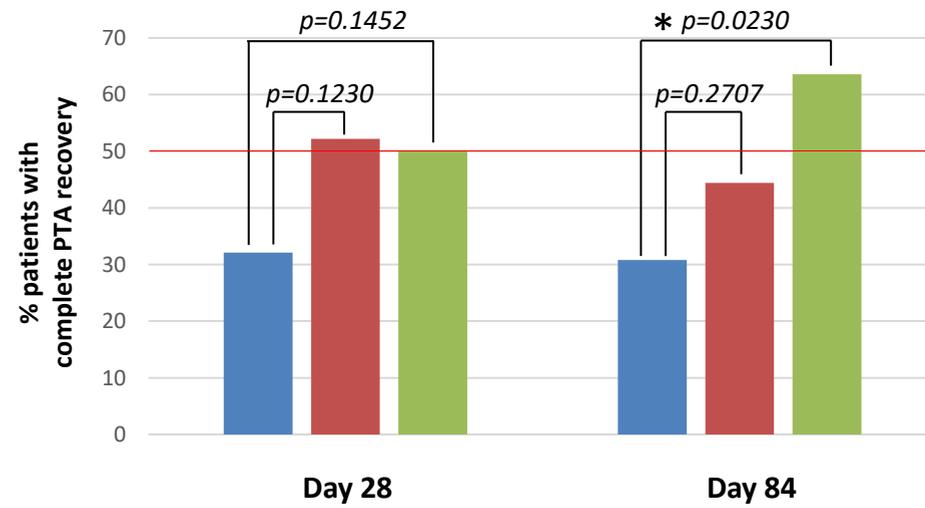
n	Day 7	Day 14	Day 28	Day 84
High Dose	13	19	21	17
Low Dose	13	21	22	21
Placebo	11	18	20	18

### Responder rate

Calculated with the data available at each visit

# SENS-401 induces complete PTA recovery in 50% of patients

## Complete PTA recovery



Complete PTA recovery (n/n total)	Placebo	High Dose	Low Dose
Day 28	9/28	12/23	13/26
Day 84	8/26	8/18	14/22

- **Complete hearing recovery** is defined as patients with hearing loss at baseline who will revert to PTA < 20 dB, considered as “normal” hearing

# SENS-401 SSNHL phase 2 results summary

## Exploring partnering opportunities

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### AUDIBLE-S SECONDARY ENDPOINT RESULTS

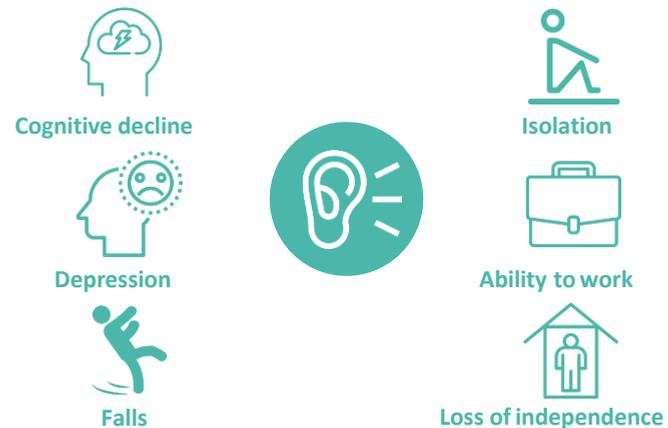
- Safe and well tolerated in 115-patient SSNHL study; primary endpoint not met
- SENS-401 shows a **clinically meaningful and statistically significant effect on PTA change over time in a large homogeneous idiopathic population of patients treated with corticosteroids**
- **Responder rate is always better in the treated group** compared to Placebo and difference with Placebo increases over time
- SENS-401 induces a **significant PTA change of at least 19dB at day 28 and up to 25 dB at Day 84 allowing a reduction of the hearing loss degree from profound to mild**
- **The change in PTA translates into functional improvement evidenced with speech audiometry tests**
- **Complete PTA recovery is achieved in 50% of the SENS-401 treated patients**

# SENS-401 clinical study submission to preserve residual hearing post cochlear implementation

## COMBINATION OF COCHLEAR IMPLANT WITH SENS-401 TO PREVENT CELL-DEATH POST COCHLEAR IMPLANT PROCEDURE

### HEALTHY AGEING

Growing understanding of the link between healthy hearing and healthy ageing



Source: Cochlear® 2018 investor day ([link](#))

**36,450**  
Implants sold  
by Cochlear®  
globally in 2021<sup>1</sup>

**\$1.5bn**  
Cochlear implant  
market in 2020<sup>2</sup>

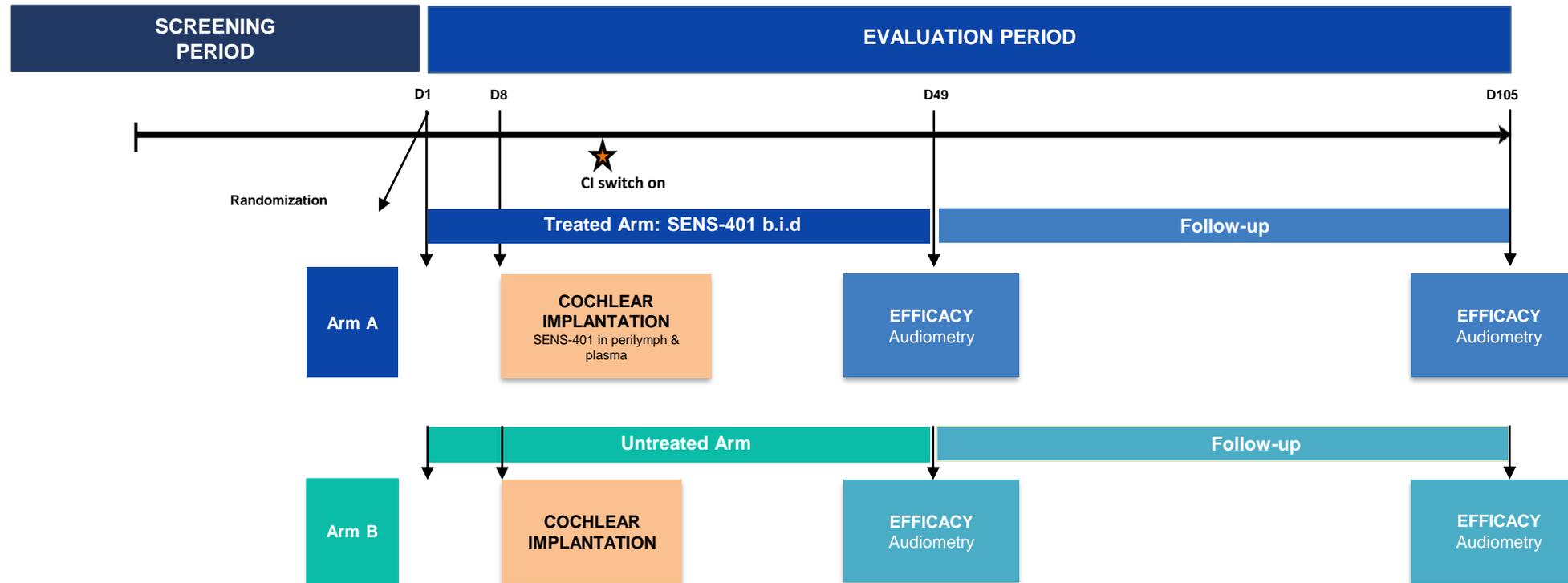
<sup>1</sup>Cochlear® 2021 financial report ([link](#))

<sup>2</sup>Market estimates ([link](#))

- In Q4 2017 Sensorion and Cochlear® entered into an agreement to evaluate whether SENS-401 in combination with Cochlear's cochlear implants can reduce cell-death from the implant procedure
- Cochlear® invested €1.6m in Sensorion equity. In exchange, Cochlear® received a right of first negotiation for a global license to use SENS-401 in combination with its implantable devices
- The two companies are progressing with a trial of SENS-401 for hearing preservation in patients scheduled for cochlear implantation. In June 2022, the proposed trial design for SENS-401 was approved by the regulatory authorities in France

# SENS-401 study design approved in France

A PHASE IIA, MULTICENTER, RANDOMIZED, CONTROLLED, OPEN-LABEL STUDY



**PRIMARY OBJECTIVE:**

To evaluate the presence of SENS-401 in the perilymph

**SECONDARY OUTCOME:**

Change of hearing threshold from baseline to the end of the study in the implanted ear at several frequencies

# Cisplatin administration for chemotherapeutic treatment of cancer damages the inner ear and leads to hearing loss, tinnitus and dizziness

## WHAT IS CIO?

### **Hearing loss caused by cisplatin administration as chemotherapeutic treatment.**

Risk factors include young age as well as individual and cumulative cisplatin doses.

CIO leads to permanent inner ear problems in 50-60% of adult cases and in 90% of pediatric cases.

### **These complications significantly impact patients' quality of life due to:**

- Hearing loss, tinnitus and dizziness impacting daily life activities
- Problems in language acquisition and learning for pediatric patients
- Difficulties in communicating, social isolation, cognitive decline

Potential treatments must not interfere with cisplatin efficacy

**Incidence of cisplatin treated patients:** 500,000 patients in 2025 in G7 countries<sup>1</sup>

<sup>1</sup> Company/ estimates based on publicly available data (in the US, Japan, Germany, France, the UK, Italy and Spain)

# SENS-401 CIO NOTOXIS

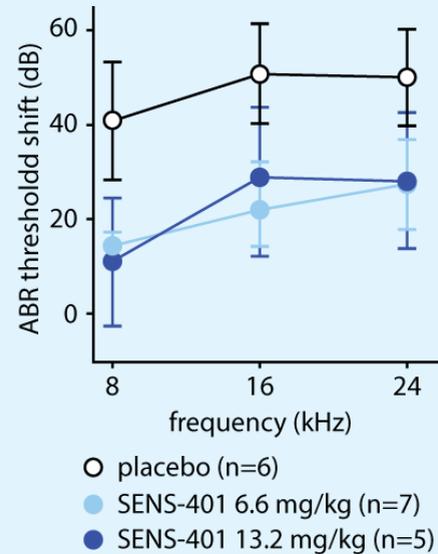
## Working on CTA amendment submission

**SIGNIFICANTLY REDUCES CISPLATIN-INDUCED HEARING LOSS AND OUTER HAIR CELL DEATH IN PRE-CLINICAL MODELS**

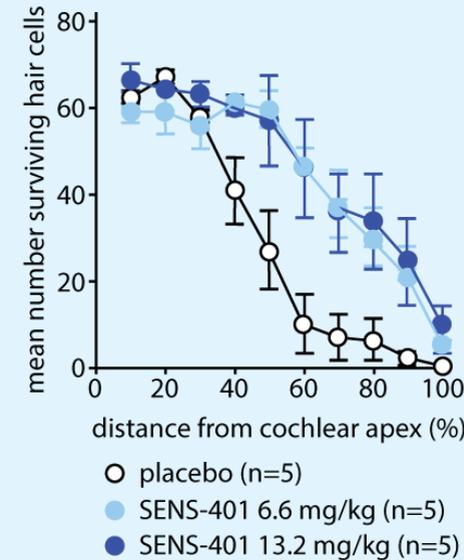
### TREATMENT PROTOCOL

SENS-401 6.6 mg/kg, 13.2 mg/kg or placebo were administered to rats once-daily for 13 consecutive days after cisplatin infusion

#### Auditory brainstem response (ABR) threshold shift at day 14



#### Cochleograms at day 14



Significant improvement versus placebo  
23-28 dB with 6.6 mg/kg (p<0.010)  
22-30 dB with 13.2 mg/kg (p<0.013)

Significant enhancement of outer hair cells survival 22-264% for both doses

Significantly more surviving outer hair cells were present after SENS-401 treatment compared with placebo (p<0.001), with up to 11-fold more in the basal turn of the cochlea

Source: Petremann et al. 2017, Otol Neurotol: Oral Administration of Clinical Stage Drug Candidate SENS-401 Effectively Reduces Cisplatin-induced Hearing Loss in Rats (link)

# SENS-401 program next steps

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CTA approval for SENS-401 study to preserve residual hearing post cochlear implementation in France H1 2022 

First patient enrolled in for SENS-401 study to preserve residual hearing post cochlear implantation mid-2022

SENS-401 CIO NOTOXIS CTA amendment submission H2 2022

SENS-401 SSNHL exploring potential partners for further developments

# Sensorion potential newsflow [estimated timelines]

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- H1 2022 – CTA approval for SENS-401 study to preserve residual hearing post cochlear implantation in France 
- Mid-2022 – First patient in for SENS-401 study to preserve residual hearing post cochlear implantation
- Mid-2022 – Delivery of toxicological batches for OTOF-GT
- Mid-2022 – GJB2-GT candidate selection
- H2 2022 – SENS-401 CIO (Cisplatin-Induced Ototoxicity) NOTOXIS CTA amendment submission
- October 31, 2022 – H1 Results
- H1 2023 – Submission of the Clinical Trial Application for the OTOF-GT program (CTA/IND)

# THANK YOU

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