If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. Non-essential images have been removed for your convenience. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.
Principles of Tinnitus:
Evaluation & Management I

Presented in partnership with Salus University

Christopher Spankovich, AuD, PhD, MPH
Associate Professor and Vice Chair of Research
University of Mississippi Medical Center

---

**Agenda**

- Introduction and Types of Tinnitus
- Neuroscience: Cochlea and Synapse
- Neuroscience: Brainstem and Cortex
- Common Approaches to Tinnitus Management
- Tinnitus Evaluation
- Summary and Q & A
Types of Tinnitus

- Subjective Tinnitus
  - Sensorineural or Neurophysiological Tinnitus
- Objective Tinnitus
  - Somatosound Tinnitus

Idiopathic transient ear noise is not regarded as tinnitus: brief high pitch sound accompanied by fullness that resolves in seconds to minutes.

Tinnitus Defined

- Perception of sound without external source
  - Transient Ear Noise vs Tinnitus
    - Lasts at least 5 minutes and occurs at least twice a week
  - Tinnitus as a normal event
  - Tinnitus as a side effect
  - Tinnitus as a disorder
  - Not one cause or etiology
- Subjective (Neurophysiological) vs. Objective (Somatosound)
  - Side effect of hearing loss/trauma
  - Pulsatile, myoclonic, patulous Eustachian tube
Tinnitus Defined

- Tinnitus that is significantly affecting an individual's quality of life is a disorder
- Tinnitus and Pain
  - Pain is a normal response that motivates the individual to withdraw as a means of protection and prevention of future experiences
  - Pain elevates from a symptom to a disorder when it becomes chronic and interferes with a person's quality of life and general function
  - Pain is psycho-physiological

Now everywhere you see Pain substitute Tinnitus

Tinnitus and Audiologist

- Working with tinnitus patients is rewarding
- Tinnitus patients are often dismissed by primary care and ENT and told they will “learn to live with it”
- Audiologists are the most capable provider to work with this population
- Working with tinnitus patients will differentiate you from the competition, whether that is a HIS or another audiologist
- Consider shadowing a seasoned clinician
Epidemiology

- Tinnitus prevalence is between 4-25% of the US population. Similar prevalence is suggested in other samples across the globe.
  - The variability is related to:
    - How tinnitus is defined
    - Sample demographics

Conservatively we can say 1 in 10 US adults has tinnitus

Epidemiology

- Only 20-25% of the tinnitus population find it to be a significant problem
  - Yet for this group tinnitus can be highly debilitating.
Epidemiology

- NHANES (Shargorodsky et al., 2010)
  - 50 million report any tinnitus
  - 16 million frequent tinnitus
  - Prevalence increases with age
  - Higher odds in non-hispanic whites
  - Hypertension, smoking, noise exposure, anxiety, and hearing loss increase odds

- US Military (Yankaskas, 2013, VA Report 2014)
  - 80% of military personnel
  - $1.2 Billion in 2012
  - Of the nearly 4 million veterans receiving benefits 32% of them have tinnitus among their service-connected compensation

- Generational Differences? (Nondahl et al., 2012)
  - More recent generations more likely to report

Epidemiology

- Tinnitus is not isolated to adults
- Approximately 7.5% of 12-19 year olds report tinnitus (at least 5 min in the past year)
- Chronic tinnitus (defined as > 3m) was found in 4.7% of the population.
- However, significant discomfort is only indicated in 0.3%.
Origin of Tinnitus: Neurophysiological

Periphery
- Hair Cell
- Neural Spontaneous Rate
  - LTP of NMDA receptors (Aspirin)
- Imbalance of afferent and efferent input

Central
- Hyperactivity
- Bursting & synchronized activity
- Imbalance in inhibitory function (e.g. GABA)
- Reorganization of mapping
- Multisensory input
- Ephaptic transmission
- Limbic System
- Dysfunctional Gating
- Gamma and alpha waves
Peripheral

- Spontaneous Otoacoustic Emissions (Gold; Penner, 1990; Liu et al., 1996)
- Discordant damage of IHC and OHC (Jasterboff, 1990)
- OHC motility --- e.g. reduced by salicylate, chronic use opposite (Chen et al., 2010)

Afferent Nerve Fibers

- Glutamate excitotoxicity (Ruel et al., 2008)
- NDMA long term potentiation (Guitton et al., 2003)
- Change in spontaneous rate (Kujawa & Liberman, 2008)

Efferent

- Total medial efferent loss had no association with tinnitus Baguley (2002)
NMDA LTP

- Aspirin (salicylate)
  - Altered Arachidonic acid metabolism increases the opening probability of NMDA receptor
- Hearing loss caused by competitive binding of prestin voltage sensor of Cl- ions, reversibly inhibiting

Tinnitus Theory

- Limits of Peripheral Theory
  - Surgical sectioning of AN has limited effect (reviewed Baguley et al., 2002)
    - Approximately 40 to 85% see no improvement in tinnitus
  - Cochlear lesions result in numerous central changes

https://commons.wikimedia.org/wiki/File:NMDA_Etoxadrol.png
**Peripheral**
- Hair Cell
- Neural Spontaneous Rate
  - LTP of NMDA receptors (Aspirin)
- Imbalance of afferent and efferent input

**Central**
- Hyperactivity
- Bursting & synchronized activity
- Imbalance in inhibitory function (e.g. GABA)
- Reorganization of mapping
- Multisensory input
- Ephaptic transmission
- Limbic System
- Dysfunctional Gating
- Gamma and alpha waves

---

**Central Theory**
- Brainstem
  - Cochlear Nucleus
  - Inferior Colliculus
- Cortical and subcortical
  - Thalamus
  - Auditory cortex and belt regions
- Non-classical auditory regions
  - Limbic system-including parahippocampus, cingulate gyrus, hippocampus, and etc.
  - Basal ganglia- caudate nucleus, putamen, and globus pallidus
    - Ventral Striatum
    - Dorsal Striatum
  - Reticular Formation
  - Somatosensory System
Tinnitus Theory

- Central (reviewed by Norena et al., 2012)
  - Central gain-compensatory price to pay
  - Abnormal amplification of spontaneous activity
  - Cross-modal plasticity
  - Reduced GABA (inhibition)

- Centralization: argues that tinnitus though starting peripherally moves centrally
- Bilateral ablation of the DCN after tinnitus, does not stop tinnitus, but ablation of DCN prevents tinnitus
- Ongoing modulation by periphery: electric stimulation and residual inhibition
Tinnitus Theory

- Central Evidence
  - Imaging (see Lanting et al., 2009)
    - Positron Emission Tomography
    - Functional Magnetic Resonance Imaging
  - Experiments
    - Sound Evoked
    - Somtaosensory
      - Oral-facial movements (Lockwood et al., 1998)
      - Cutaneous-evoked (Cacace et al., 1999)
      - Gaze-evoked (Giraud et al., 1999)
    - Lidocaine (Mirz et al., 2000)
    - Residual inhibition (Osaki et al., 2005)

Tinnitus Theory

- Brainstem
  - Cochlear Nucleus
    - Increased spontaneous firing rate (Kaltenbach et al., 2006)
    - Loss of inhibition (Caspary et al., 2005)
  - Inferior Colliculus
    - Increased spontaneous firing rate (Ma et al., 2006)
    - Loss of Inhibition (Caspary et al., 2008)
**Tinnitus Theory**

- Somatosensory system:
  - Complex system of sensory neurons that respond to temperature, touch, pain
  - All afferent touch info ascends the spinal cord via the medial lemniscus pathway via gracilis or cuneatus
  - The cuneatus sends signals to the cochlear nucleus to determine if vibration is sound
  - Somatosensory neurons are susceptible long term potentiation (LTP)


- Cortical and subcortical (as reviewed by Lanting et al., 2009)
  - Thalamus
  - Primary Auditory Cortex
  - Secondary Auditory Cortex and Association Areas
Tinnitus Theory

- Central (reviewed by Norena et al., 2012)
  - Changes in temporal coherence of neural activity within and across brain regions
    - Decreased alpha activity and increased gamma have been demonstrated

- Non-classical auditory
  - Limbic System & Frontal Lobe
    - Dorsal and Ventral Striatum
  - Cerebellum

Tinnitus results from central nervous system changes triggered by peripheral lesions, including hearing loss and other neural insults (Norena et al, 2012).

- Does a normal audiogram mean normal auditory function?
- Why do people with hearing loss not have tinnitus?
Continued

https://commons.wikimedia.org/wiki/File:Nucleus_accumbens.jpg

Sweetow, 2012
Tinnitus Neuroscience Summary

- Tinnitus is a spectrum based percept, most commonly a consequence of changes in auditory and non-auditory neural networks following damage to the cochlea. Homeostatic compensatory mechanisms occur after hearing loss and these mechanisms alter the balance of excitatory and inhibitory neurotransmitters. In many individuals with hearing loss, chronic tinnitus and related phenomena emerge. Some people with tinnitus are disturbed by this subjective sensation. When auditory network dysfunction is coupled with limbic-gating dysfunction, an otherwise meaningless auditory percept such as tinnitus may acquire negative emotional features.


Breakdown of Popular Approaches
Question??????

- What approach for tinnitus management do you currently use?
  A. Tinnitus retraining therapy
  B. Tinnitus activities treatment
  C. Modified version (my own thing)
  D. Don’t provide any formal counseling, just basic education and hearing aids when appropriate
  E. Use Proprietary approach (neuromonics, soundcure, etc.)
  F. Don’t see tinnitus patients

Approaches Overview

- Numerous approaches to tinnitus have been developed over the past few decades
  - Sound therapies (Many variations with and without counseling)
  - Cognitive Behavioral Therapy influenced Counseling (Many contributors)
    - Tinnitus Activities Treatment (Tyler and colleagues)
    - Integrated Approach to Tinnitus Patient Management (Sweetow and colleagues)
  - Tinnitus Retraining Therapy (Jastreboff and colleagues)
  - Progressive Tinnitus Management (Henry and colleagues)
  - Patient Centered Therapy (Acceptance of tinnitus as part of me (Mohr and colleagues)
  - Acceptance and Commitment Therapy (Hesser, Westin, and others)
  - Mindfulness based tinnitus stress reduction (Gans)
  - Combination of the above or modified approaches (Many others)
Approaches Overview

- Though there are philosophical differences in these approaches, they also have a great deal in common.
  - Counseling of some type: Common
  - Sound therapy of some type: Common
  - None treat tinnitus, but rather the reaction to tinnitus
  - Some potential differences are the areas emphasized in counseling, perspectives of directive vs. collaborative interaction with patient, idea of classical conditioning vs. operant conditioning, and level setting and type of sound for sound therapy

Approaches Overview

- Classical conditioning vs. Operant conditioning

https://commons.wikimedia.org/w/index.php?curid=3487621
https://commons.wikimedia.org/w/index.php?curid=19270394
Approaches Overview

- **Tinnitus Retraining Therapy**
  - Developed by Jastreboff and Hazell over 25 years ago
  - Based on the Neurophysiological Model of Tinnitus
    - Auditory system is secondary, primary are non-auditory regions (in particular limbic system)
  - Primarily uses directive/educational counseling
  - Primary goal is habituation of reaction and/or perception of tinnitus
  - Patients can be categorized based on perception of tinnitus, perceived hearing loss, and sound sensitivity
  - Sound therapy component suggest a “mixing point”

---

Tinnitus Retraining Therapy (TRT)

- Jastreboff started development of TRT in the 1980s
- Based on a neurophysiological model where auditory and non-auditory regions were responsible for troublesome tinnitus
- Treatment should be focused on altering these connections
- Sound therapy focused not on masking but relief
- Treatment focused on making tinnitus neutral stimulus rather than eliminating its perception
A meeting with Hazell evolved into formalizing basic TRT elements
- Directive counseling to explain model
- Use of partial masking (mixing point)
- Extinction of the subconscious conditioned reflex between the auditory system and the limbic system/ANS
- Applicable to any type of tinnitus

- Neurophysiological Model According to TRT
  - Creates a feedback loop
    - Negative perception and reaction increases attention, which, in turn, enhances the detection by subcortical regions increasing activation of the limbic and ANS system
    - Places emphasis on the subconscious pathway, though recognized the conscious pathway in the establishment of tinnitus
    - Tinnitus is not the problem, it is normal, the reaction is abnormal; an aversive conditioned reflex is created and must be habituated
TRT

- Outline of Treatment
  - Habituation is the key
    - Reaction: reclassify the tinnitus via retraining counseling as a neutral stimulus
    - Perception: reduce the strength of the tinnitus signal to ease habituation

TRT Criticisms

- Uses directive counseling and not collaborative with patient
  - Jastreboff has recently used “educational counseling” rather than directing and points that it should be interactive
- Does not consider cognitive domain
  - Jastreboff has commented that the cognitive domain is critical for the initial negative association, but the subconscious pathway dominants later and it is the focus of habituation
- Partial masking is no more effective than other masking approaches for habituation
  - Jastreboff has said sound is dependent on each patient as well as need for amplification and that the level should be set that it diminishes perception but not mask, this does not mean it needs to be set at a place where the tinnitus is barely perceived, does not need to be ear level devices and does not need to be white noise
Approaches Overview

- Cognitive-behavioral therapy and tinnitus
  - CBT (Psychotherapy)
    - Consists of face to face sessions, anywhere from 6-18, for around an hour each, over many weeks, occasional “booster” sessions are provided
    - Performed by a licensed therapist/psychologist in CBT
    - Good idea to find someone in your area as a referral source, if no one in your area there are telehealth alternatives

CBT and Tinnitus

- Psychological factors in treating tinnitus include:
  - Cognitive domains
  - Learning
  - Emotional domains
  - Attention
  - Negative Automatic Thoughts
    - Uninvited-just pop in your head
    - Plausible- have a grain of truth
    - Middle of night worrying quality
    - Unhelpful
    - Involuntary
CBT and Tinnitus

- Maladaptive Thoughts
  - All or none thinking: view situation in black or white; “because of tinnitus I cannot enjoy my life”
  - Catastrophizing (fortune telling): predict a negative outcome; “my tinnitus will only get worse and worse”
  - Discounting positive: telling self positive does not count; “I am ok when noise around, but can’t enjoy quiet”
    - Magnification and minimization
  - Emotional reasoning: thing something is true based on feeling and ignoring contradictory information; “I have coped with many things in life, but this tinnitus is overwhelming me”
  - Labelling: putting a global label on things; “my life is over because of the tinnitus”
  - Overgeneralization: sweeping negative conclusions based on an experience; “my tinnitus got worse after that cup of coffee, I need to completely remove coffee from my life”

- Challenging Maladaptive Thoughts
  - All or none thinking: view situation in black or white; “because of tinnitus I cannot enjoy my life”
    - That is not true, there are many things you likely enjoy and will continue to enjoy
  - Catastrophizing (fortune telling): predict a negative outcome; “my tinnitus will only get worse and worse”
    - I understand your concern, but the evidence suggests the opposite. In most cases the bothersomeness of tinnitus diminishes with time as the brain naturally habituates (give examples).
  - Discounting positive: telling self positive does not count; “I am ok when noise around, but can’t enjoy quiet”
    - You just made a significant statement, you can spend some portion of your day with sound that allows you relief from your tinnitus. Let’s discuss how we can use this to our advantage.
Challenging Maladaptive Thoughts continued…

- Emotional reasoning: thing something is true based on feeling and ignoring contradictory information; “I have coped with many things in life, but this tinnitus is overwhelming me”
  - The tinnitus is significant distress for you now, but comparable to the other issues you have suggested overcoming, you will overcome this as well. It makes sense for the brain to view this as an alarm, but……..
- Labeling: putting a global label on things; “my life is over because of the tinnitus”
  - Your life is not over, and the tinnitus itself is not a life threatening symptom, however our reaction to tinnitus can affect our life in a negative manner. View the tinnitus as an alarm, an alarm it is time to start taking better care of you, eating healthy, doing the things you enjoy.
- Overgeneralization: sweeping negative conclusions based on an experience; “my tinnitus got worse after that cup of coffee, I need to completely remove coffee from my life”
  - It is common for foods, sound, etc to potentially create transient changes in your tinnitus, in most cases these changes are only temporary and your tinnitus will return to its usual perception. Let’s discuss recommendations to reduce risk for worsening tinnitus and also discuss scenarios where you may experience transient spikes and why this may occur. Not matter if the tinnitus changes your brain can still habituate.

Approaches Overview

- The Audiologist and Cognitive-behavioral therapy and tinnitus
  - CBT-based approaches (Adjustment Counseling)—Audiologist provided
    - CBT-based approaches (Adjustment Counseling)—consists of application of CBT principles often with sound-based therapy and other techniques like relaxation training, imagery, and etc.
    - Robert Sweetow, PhD: “patient may reject a purely psychological approach, instead patient should be counseled on physiological origin, but the reaction is ultimately a psychological interpretation”
    - Sweetow-Integrated Approach is the basis of the Widex Zen Therapy
CBT and Tinnitus

- Know your limitations
  - Professional Counseling
  - Psychology vs. Psychiatry
  - Introduce these concepts early in process

Tinnitus Activities Treatment

- Developed by Tyler and Colleagues and is based in principles of CBT
- Interactive counseling with sessions covering topics
  - Thoughts and Emotions
  - Sleep
  - Hearing and Communication
  - Concentration
- Picture-based materials are used to reinforce the concepts
- Attention on issues patient is having, discussing strategies to specific issues, and involves use of diaries and homework (activities)
- https://www.medicine.uiowa.edu/oto/research/tinnitus-and-hyperacusis
Our Thoughts and Emotions

- Doorbell → Neutral
- Doorbell → Fire → Injury → Anxiety
- Doorbell → Angry neighbor → Anxiety
- Doorbell → Flowers → Friend → Happiness
- Doorbell → Prize → Happiness


PTM

- Developed to create 5 hierarchical levels of tinnitus management
- The aim is to provide sufficient management to meet patients needs, while reducing effort and expense

James Henry, PhD
Tinnitus Therapies

- Reduce Contrast
- Mask Phantom Percept
- Suppress Hyperactivity
  - Examples
    - Maskers
    - Hearing Aids
    - “Neuromonics”
    - “Zen” Fractal tones
    - “Sound Cure”
    - Co-ordinated Reset Stimulation
    - Cochlear Implants

- Reclassify Phantom Percept
- Reduce Saliency
- Mitigate Emotional Distress
  - Examples
    - Tinnitus Retraining
    - Neuromonics
    - Widex Zen Therapy
    - Antidepressants
    - Cognitive-behavioral therapy
    - Mindfulness Based Stress Reduction

Auditory-Striatal-Limbic Connectivity

Disrupt Information Conveyance
Avoid Interference with Audition
  - Examples
    - Striatal Neurmodulation
    - Vagal nerve stimulation
    - Cortical Stimulation (rTMS)

Sweetow, 2010

---

Tinnitus Evaluation
Differential Diagnosis

- Subjective/Neurophysiological Tinnitus
  - Tumor (vestibular schwannoma)
  - Microvascular compression of 8th Nerve
  - Herpes (Ramsay Hunt)
  - Tempromandibular joint disorders
  - Lyme disease
  - Meniere’s Disease
  - Other neurological (MS, ALS, PD)
  - Head/neck trauma or iatrogenic
  - Medication
  - Infection
  - Hearing Loss

Differential Diagnosis

- Auditory Hallucinations
  - Raises concerns for medications, focal neural injury, or mental instability. Also consider stress!
  - Verbal
    - Voice that may or may not be intelligible
  - Non-Verbal (acoasms)
    - Non-human sounds and music
Differential Diagnosis

- Normal Hearing and Tinnitus
  - Head, neck, other trauma
    - Ephaptic Neural Transmission
  - Central pathology
  - Medication
  - Sub-clinical damage
    - Hair Cell (20-30% OHC loss and no change in threshold)
    - Synaptopathy (80% loss of synapses and no change in threshold)
  - Morales-Garcia et al. 2010– showed caloric test abnormality in 15 of 17 tinnitus patients with normal audiometric evaluations

Differential Diagnosis

- History
  - Onset: Sudden vs. Gradual
  - Timing: Association with event (e.g. noise)
  - Tinnitus quality
    - Localization
    - Sounds analogy
    - Somatosound
  - Hearing
    - Sudden loss, asymmetry, fluctuation, fullness, ear pain, ear discharge
  - Vertigo
    - True vertigo
    - Imbalance
  - Migraines

- Other Health and Symptoms
  - Cardiovascular
  - Neurological
  - Thyroid
  - Diabetes
  - Infection: viral or bacterial
  - Pregnancy

- Medications
  - Ototoxic
  - NSAIDS
  - Statins
  - Anxiety and Depression
  - Viagra
  - Synthroid

- Psychology and Affect
- Other things to consider
  - Outdoors person: Lyme Disease
  - Hyperacusis
Tinnitus

- **Onset** - gradual vs. sudden
- **Correlation** - recent cold/flu, noise exposure, new medications, barotrauma, hiking?, trauma (car accident), etc.
- **Medications** - statin, salicylates, drugs, chemo, antibiotics, acetamphenophen, diuretics, anti-malaria, oral contraceptives
- **Other conditions** - diabetes, cardiovascular, neural, thyroid, pregnancy, infection, etc.
- **Other symptoms** - hearing loss, sensitivity to sound (hyperacusis), dizziness, fatigue, cardio, neural (pins and needles, etc.), headaches, pain, aural fullness, otorrhea, otalgia, slurred speech, facial paralysis, etc.
- **Psychological** - history of anxiety, depression, C-O-D
- **Tinnitus** location, sound-like, change in quality?, make it change?
- **Who have they seen**: ENT, Otologist, Neurologist, Cardiologist, Endocrinologist, Psychologist/Psychiatrist, Oncologist, etc
- **Dietary deficiencies, what is their diet**
- **Other Lifestyle**
Where is your tinnitus primarily localized, where do you perceive its origin?

The head __ Right ear __ Left ear __ Both ears equally

Other please explain...

Check all items below that describe the sound of your tinnitus:

- Ringing
- Buzzing
- Clicking
- Whoosh
- Tea kettle
- High-pitched noise
- Squeaking gate
- Ocean roar
- Clicking
- Rattling
- Flickering
- Pulping
- Material sound
- Other please describe...

Using the scale below, indicate the loudness of your tinnitus (write number in blank):

Now __ Average __ At its worst __ At its best

Using the scale below, indicate the pitch of your tinnitus, pitch meaning like on a piano scale from lower bass like sounds to higher pitch treble sounds (circle on scale).

1 2 3 4 5 6 7 8 9 10

Does your tinnitus fluctuate? (check one)

- Fairly constant day to day
- Fluctuates widely, very loud some days and very mild other
- Usually constant, but occasionally decreases
- Usually constant, but occasionally increases
- Can vary with loud position or movement

Most persons with tinnitus can listen and hear their tinnitus at any time during the day, but others can go some period of time not actively paying attention to the tinnitus, how much of the day are you actively engaged in perceiving your tinnitus? (check one)

- 24 hours / 7 days a week, can't ignore, always present, even in noise and when distracted
- About 50% of the day
- About 25% of the day
- Only present in very quiet
- Only present when going to bed or waking from sleep

Does your tinnitus appear worse or more bothersome (check all that apply):

- When tired
- When stressed
- When you have a head cold
- At bedtime
- When performing a task (e.g. reading)
- After use of alcohol
- After specific food or medication
- When you are awake
- When you sleep
- When you are active
- When you have noise exposure
- When you are stressed
- When you are relaxed
- When you are active
- Other describe...

Because of your tinnitus (check all that apply):

- You can't sleep
- You are depressed
- You can't hear as well
- You are frustrated
- You have stopped going out or socializing
- You have stopped a hobby or something you enjoy (describe...)
- You feel you can't escape the tinnitus
- You feel you can't enjoy life
- You feel that if the tinnitus would be happy
- You have change in balance

To what extent are you bothered or annoyed by your tinnitus? (circle)

1 2 3 4 5 6 7 8 9 10

Have you discussed your tinnitus with your family or friends?

- Yes __ No

What was their reaction?

Do you feel like you have hearing loss?

- Yes __ No

Which ear?

- Right ear __ Left ear __ Both ears equally __ One side worse

Other please explain...

Was the hearing loss sudden or gradual? (circle sudden or gradual)

Have you had a hearing test in the past year?

- Yes __ No

Have you ever worn hearing aids?

- Yes __ No

Do you feel like you are more sensitive to sounds? (if yes check all that apply)

- Yes __ No

- Album sounds
- Only high pitch loud sounds
- Moderate loud sounds
- Soft sounds (e.g. chewing, scraping, etc.)
- All sounds
- Specific sounds

Please list all evaluations and treatments you have had for your tinnitus/hyperacusis, including imaging, surgery, counseling, EMT, and etc.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Reason</th>
<th>Date</th>
</tr>
</thead>
</table>

Please list all current and past medications you have used to help with your tinnitus/hyperacusis, including the over the counter products and herbal remedies.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Frequency</th>
</tr>
</thead>
</table>

Other please explain...
Tinnitus Sound Has No Diagnostic Importance, Except (J. Hall III)

Description of types of tinnitus for >100 patients

- ringing = 47
- crickets = 21
- high-pitch tone = 17
- hissing = 13
- humming = 13
- roaring = 6
- static noise = 5
- buzzing = 4
- pulsing = 4

- clicking = 2
- frying sound = 2
- mid-pitch tone = 1
- screeching = 1
- whizzing = 1
- fizzing = 1
- siren = 1
- crackling = 1
- running water = 1
Tinnitus Evaluation

- Medical Evaluation (preferably Otologist)
- Tinnitus Inventories
- Audiometry
- Immittance
- Otoacoustic Emissions
- Tinnitus Evaluation (CPT Code 92625)
  - Pitch Match
  - Loudness Match
  - Minimum Masking Level
  - Residual Inhibition
  - Loudness Discomfort Levels (Hyperacusis)
Tinnitus Evaluation

- **Tinnitus Inventories**
  - Tinnitus Handicap Inventory (Newman et al., 1996)
  - Tinnitus Reaction Questionnaire (Wilson et al., 1991)
  - Tinnitus Functional Index (Meikle et al., 2012)
**Tinnitus Handicap Inventory (THI)**
A 25-item self-report questionnaire that takes approximately 10 minutes to complete.
Scoring takes 5-10 minutes with a score of 4 for Yes, 3 for Sometimes, and 0 for No.

<table>
<thead>
<tr>
<th>Points</th>
<th>4</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Because of your Tinnitus, is it difficult for you to concentrate?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2. Does the buzzing of your Tinnitus make it difficult for you to hear people?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3. Does your Tinnitus make you angry?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4. Does your Tinnitus make you confused?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5. Because of your Tinnitus, are you desperate?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>6. Do you complain to a great deal about your Tinnitus?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>7. Because of your tinnitus, do you have trouble falling asleep at night?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>8. Do you feel as though you cannot escape from your Tinnitus?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>9. Does your Tinnitus interfere with your ability to enjoy social activities (such as going out to dinner, to the cinema)?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>10. Because of your Tinnitus do you feel frustrated?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>11. Because of your Tinnitus do you feel that you have a terrible disease?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>12. Does your Tinnitus make it difficult to enjoy life?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>13. Does your Tinnitus interfere with your job or household responsibilities?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>14. Because of your Tinnitus do you feel that you are often irritable?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>15. Because of your Tinnitus, is it difficult for you to read?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>16. Does your Tinnitus make you upset?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>17. Do you feel that your Tinnitus has placed stress on your relationships with members of your family and friends?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>18. Do you find it difficult to focus your attention away from your Tinnitus and on to other things?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>19. Do you feel that you have no control over your Tinnitus?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>20. Because of your Tinnitus do you often feel tired?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>21. Because of your Tinnitus do you feel depressed?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>22. Does your Tinnitus make you feel anxious?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>23. Do you feel you can no longer cope with your Tinnitus?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>24. Does your condition get worse when you are under stress?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>25. Does your Tinnitus make you feel insecure?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

---

**Tinnitus Reaction Questionnaire (TRQ)**
This questionnaire is designed to find out what effect tinnitus has had in your life in the recent past.

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>Sometimes</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My tinnitus has made me anxious</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. My tinnitus has made me feel depressed</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. My tinnitus has made me feel sad</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. My tinnitus has made me feel angry</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. My tinnitus has made me feel embarrassed</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. My tinnitus has made me feel nervous</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. My tinnitus has made me feel helpless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. My tinnitus has made me feel frustrated with things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. My tinnitus has使我feel helpless with people</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. My tinnitus has made me feel helpless with my work</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11. My tinnitus has made me feel helpless with my home life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12. My tinnitus has made me feel helpless with my personal life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13. My tinnitus has made me feel helpless with my social life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. My tinnitus has made me feel helpless with my family</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15. My tinnitus has made me feel helpless with my friends</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16. My tinnitus has made me feel helpless with my work</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17. My tinnitus has made me feel helpless with my home life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18. My tinnitus has made me feel helpless with my personal life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19. My tinnitus has made me feel helpless with my social life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20. My tinnitus has made me feel helpless with my family</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21. My tinnitus has made me feel helpless with my friends</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>22. My tinnitus has made me feel helpless with my work</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>23. My tinnitus has made me feel helpless with my home life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24. My tinnitus has made me feel helpless with my personal life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>25. My tinnitus has made me feel helpless with my social life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>26. My tinnitus has made me feel helpless with my family</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>27. My tinnitus has made me feel helpless with my friends</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
**Tinnitus Functional Index**

**Subscale Name (and conceptual content) | Items in Subscale**
--- | ---
I. Intrasitive (unpleasantness, intrusiveness, persistence) | #1, #2, #3
II. Sense of Control (Reduced sense of control) | #4, #5, #6
III. Cognitive (cognitive interference) | #7, #8, #9
IV. Sleep (Sleep disturbance) | #10, #11, #12
V. Auditory (Auditory difficulties attributed to tinnitus) | #13, #14, #15
VI. Relaxation (interference with relaxation) | #16, #17, #18
VII. Quality of Life (QOL) (Quality of life reduced) | #19, #20, #21, #22
VIII. Emotional (emotional distress) | #23, #24, #25
Tinnitus and Hearing Survey

- Differentiating between tinnitus and hearing complaints
  - Critical and part of Progressive Tinnitus Management
- It is common for patients to report tinnitus complaints but really the issue is their hearing
- Cut-offs scores not recommended, rather a guide to help the clinician determine best intervention
  - Henry et al. 2015

Tinnitus Evaluation

- Otoscopy
- Audiometry
  - Extended High Frequency?
  - Edge f (Moore et al., 2010)
  - Maximum loss f (Schecklmann et al., 2012)
- Impittance
  - Somatosound Tinnitus
  - Decay on 35 dB HL
- Otoacoustic Emissions
  - Demonstrate cochlear dysfunction with normal hearing
  - Recommend two levels 65/55 and 55/40 and as high frequency as can go
Tinnitus Evaluation

- Pitch Match (reviewed by Henry et al., 2005)
  - Tinnitus ear and Stimulus Ear
  - Loudness vs. Pitch
  - Start at 1kHz, move in octave intervals using forced choice
    - Sound 1 or 2, which is closer, not going to get an exact match
  - Tone or noise?
  - There’s an app for that!
  - Tyler and Conrad-Armes (1983) recommend repeating at least 7 times

- Loudness Match (reviewed by Henry et al., 2005)
  - After you match pitch, you can start the matched frequency below threshold and slowly increase in 1 to 2 dB steps until match the level of the tinnitus
  - Can also use 1kHz to match level
  - Average 10-15 dB SL
  - Repeat several times in each ear and take the average
Tinnitus Evaluation

- Minimum Masking Level (reviewed by Henry et al., 2005)
  - Start by finding threshold for white noise in both ears
  - Lowest level we can play noise to mask tinnitus
  - Monaural L and R and Binaural conditions
  - Obtain threshold for white noise first
  - 1 to 2 dB steps increase
  - Can try other types of noise

- Residual Inhibition
  - Phenomenon where tinnitus is reduced or eliminated following auditory stimulation
  - Can be difficult to achieve
  - Present noise at 10 dB above MML for 1 minute, shut off noise and start timing or indicate how much reduced
    - Neural adaptation (Young & Sachs, 1973)
Tinnitus Evaluation

- Other testing
  - TEN test
    - Set TEN level usually 70 dBHL, measure threshold for tone, should be around 70 dB HL or a few dB over with cochlear loss
    - Dead region if need to make greater than 10 dB
  - Electrophysiologic
    - ABR growth functions?
  - Loudness discomfort levels (Hyperacusis or sound sensitivity)
    - Minimally at octave frequencies 1 to 8 kHz
    - Speech

Billing and Coding

- Tinnitus Evaluation (CPT 92625)
  - Medicare reimburses ~ $70.00
- Other: Comprehensive Audiological Evaluation ~ $34.00, DPOAEs comprehensive (min 12 f) ~$30.00, Tympanometry and Reflexes ~$20.00
  - Can probably do all that testing in 30-40 min and look at about $150
- Counseling: No Code, Charge out-of-pocket based on your time or patient complexity, I have heard of everything from $0 to really high; Consider your break-even hourly rate and adjust as needed
- Most patients are hearing aid candidates or would benefit from ear level devices
  - Class I vs II medical device
  - Consider carrying sound pillows and other sound therapy devices
- Tinnitus H93.1(.11-.14)
Summary

- Tinnitus patients are a rewarding group to work with
  - How often do you hear “you saved my life”
- Our knowledge of tinnitus neuroscience is evolving, as clinicians it is our duty to stay on top of the literature
  - Tinnitus is a result of changes in auditory and non-auditory pathways
- Numerous counseling and “treatment” approaches
  - No evidence one is the “best”
  - Most aim to treat reaction not the actual tinnitus
- The tinnitus evaluation is fairly easy to administer and can be performed with your current equipment
- Next Time: Dive into more specifics on counseling, sound therapies and other treatments, and perform a case walk through

Questions????????????????