Objectives

- Learners will be able to:
  - Demonstrate sanitary procedures that protect the member, practitioner, and staff when involved with the dispensing, fitting, and maintenance of hearing instruments.
  - Demonstrate sanitary protocols for cleaning and sanitizing equipment and surfaces in the practice environment.
  - Name the landmarks of the pinna, external ear canal, and tympanic membrane.
  - Describe the resonance characteristics of the external auditory canal
  - Identify conditions in the outer ear that require medical referral and/or may impact hearing testing and/or hearing instrument fitting and follow-up.
  - Identify the structures of the middle ear.
  - Discuss the impedance matching function of the middle ear.
  - Recognize the middle ear muscle that is involved with the acoustic reflex.
  - Discuss the structure and function of the Eustachian tube.
“Infection control is a process that involves the rigorous management of the clinical environment for the specific purpose of minimizing the potential spread of disease.”

“Infection prevention and control measures aim to ensure the protection of those who might be vulnerable to acquiring an infection both in the general community and while receiving care due to health problems, in a range of settings. The basic principle of infection prevention and control is hygiene.”

~World Health Organization
Definitions

Cleaning – removal of gross contamination without necessarily involving the process of killing germs.

Disinfecting – process whereby germs are killed.

Sterilization – process whereby 100% of germs are killed.

Disposable Items – items designed for one-time use.

Touch Surface – any member care surface that may potentially come in direct or indirect contact with hands.

Standard Precautions

1. Use of Personal Protective Equipment (PPE)
2. Hand Hygiene
3. Cleaning and disinfecting touch and splash surfaces
4. Sterilizing critical instruments
5. Waste Disposal
Standard Precautions - PPE

Gloves:
- Nitrile Gloves must be used at Costco Hearing Aid Centers per our protocol.
- Must be worn for **any member contact** per our protocol.
- Must also be worn when handling contaminated objects.
  - *NEVER* accept hearing aids in your bare hands!
  - Must be worn when handling ear impressions.
- Gloves must fit like a second skin.
  - When gloves are loose your ability to hold and manipulate tools is compromised.
  - When gloves are too tight it can cause fatigue and decrease dexterity.
- Gloves are disposable – *One time use only!*

Standard Precautions – PPE

Masks, Aprons, and Eye Protection

Disposable masks, aprons or lab coats, and eye protection in the form of safety glasses are necessary when there is a risk of splash or splatter of infectious material, or when a clinician and/or member is at risk of airborne contamination.
- Hearing Instrument/Earmold modifications
- Working with Cavicide/Sporox II

When in doubt read the label – if it doesn’t specify, check the SDS sheet.
Standard Precautions – SDS Sheets

Click the “Safety/SDS Disaster Info.” link.

Click the “Hear/Read / SOS” link.
Standard Precautions – SDS Sheets

Click the paper to open the SDS sheet for your product

Standard Precautions – SDS Sheets
Standard Precautions – SDS Sheets

**Section 8. Exposure Controls / Personal Protection**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Exposure Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>None (stationary)</td>
</tr>
<tr>
<td>Isopropanol</td>
<td>200 ppm TWA, 400 ppm STEL</td>
</tr>
<tr>
<td>Ethylene Glycol Monobuty Ether (2-Butoxyethanol)</td>
<td>20 ppm TWA ACGIH TLV</td>
</tr>
<tr>
<td>Diisobutyl/phenyloxyethyloxyethyl benzylammonium chloride</td>
<td>None Established</td>
</tr>
</tbody>
</table>

**Appropriate Engineering Controls:** General ventilation should be adequate for normal use. For operations where the exposure limits may be exceeded, mechanical ventilation such as local exhaust may be needed to minimize exposure. Use explosion proof electrical equipment and wiring where required.

**Respiratory Protection:** None under normal use conditions with adequate ventilation. For operations where the occupational exposure limits are exceeded, an approved respirator with an organic vapor cartridge or supplied air respirator is recommended. Equipment selection depends on contaminant type and concentration. Select in accordance with applicable regulations and good industrial hygiene practice. For firefighting, use self-contained breathing apparatus.

**Hand Protection:** Impermeable gloves such as butyl rubber or nitrile are recommended for operations which may result in prolonged or repeated skin contact.

**Eye Protection:** Splash proof goggles, face shield, or safety glasses are recommended to prevent eye contact.

**Skin Protection:** Wear protective clothing if needed to avoid prolonged repeated skin contact. Contaminated clothing should be removed and laundered before reuse.

**Hygiene measures:** Suitable eye wash and washing facilities should be available in the work area.

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Standard Precautions – SDS Sheets

**Section 7. Handling and Storage**

**Precautions for Safe Handling:** Do not get in eyes or on clothing. Wear appropriate eye protection, protective clothing and gloves. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Remove and wash contaminated clothing before reuse.

Flammable liquid and vapor. Keep away from heat, sparks, open flames and all other sources of ignition.

Do not smoke in storage or use areas. Keep containers closed when not in use. Do not reuse empty containers.

**Conditions for Safe Storage, including any Incompatibilities:** Store in a cool, well ventilated area away from heat; oxidizers and all sources of ignition. Do not contaminate water, food or feed by storage.

Empty containers retain product residues and may be hazardous. Do not flame cut, drill, weld, etc. on or near empty containers, even empty.
Standard Precautions – Hand Hygiene

Hand hygiene is the single most important precaution for limiting the spread of disease!

– Before and after any process
– If you come into fluids of any type (blood, body fluids, non-intact skin, cerumen, etc.)
– After gloves are removed
– Before eating, after using the restroom, after smoking, and after coughing or sneezing into a tissue
– Any other time you feel it’s warranted

Standard Precautions – Hand Hygiene

Remember:
Hand hygiene is the single most important thing we can do to protect the member and ourselves!
Touch surfaces that come into direct or indirect contact with the member and/or you (the dispenser) must be cleaned and then disinfected prior to the next member appointment.

- Counters, chairs, computer keyboard and mouse...
- Any part of the equipment that touched the member
  - Headphones, Bone Oscillator, Response Button, REM assembly...

Cleaning – Think germicidal cloth
Disinfecting – Think disinfectant

Cleaning Tools:
- What is the tool made of?
- Will it fit in the container you are using?

Clean it:
- Germicidal Wipe or Ultrasonic Cleaner
Disinfect it:
- Ultrasonic Cleaner or Cold Bath
Standard Precautions – Cleaning & Disinfecting

Hearing Aids:
• Can it be submerged?
  – Earmolds?
  – Electronics?
Clean it:
• Earmold – Ultrasonic Cleaner
• Hearing Aid – Germicidal Wipe
Disinfect it:
• Earmold – Cold Bath
• Hearing Aid – A New Germicidal Wipe

The Booth and Work Surfaces:
• Any surface that has come into contact either directly or indirectly with the member, their hearing aids, or you during the course of a workflow needs to be cleaned and disinfected.

• Cleaning – Germicidal Wipe
• Disinfecting – Spray Disinfectant
Reusable items inserted in the ear canal (Syringes, earlight tips, etc.), tools used for hearing aid cleaning, stethoscope tips can and will get contaminated with cerumen and must be cleaned and then sterilized prior to reuse.

Clean them with a germicidal wipe to remove any visible contaminates.

Sterilize them by placing them in the cold bath or ultra sonic cleaner for the amount of time specified on the label and follow all directions.

*Products that meet the EPA’s cold sterilant requirements include those containing 7.5% or higher concentration of hydrogen peroxide (H2O2)*

**Standard Precautions – Sterilization**

- Many of the items we use can be thrown in the trash
  - Gloves, specula, REM tubes, etc.
- Chemicals and their containers must be properly disposed of through the RTV bucket program using proper Costco Procedures and SOP’s

**Standard Precautions – Waste Disposal**
To comply with state and federal laws regarding the disposal of products, the hearing aid center has several SOP’s.

- Empty Containers
- Battery Recycling
- Used Hearing Aids/Accessories Disposal
- Used Hearing Aid Receiver Disposal
- Used Impression Material Containers
- Unused Impression Material
- Disinfectant Disposal

SOP – Empty Containers

Hazardous Materials can not be thrown in the trash.

Some hazardous containers, once emptied, can safely go into the trash.

Write "EMPTY" and the date on the container with a permanent marker prior to disposing or recycling it.

Some containers are NEVER considered empty, for example aerosol cans and items that leave a residue.

A container is considered empty if there is not a steady stream when turned upside down.

If a container can not be considered empty, review Option S.T.O.P. and manage it in the RTV Bucket Program.
SOP – Empty Containers (CA Only) 1 of 2

Standard Operating Procedure - Handling Empty Containers - CALIFORNIA ONLY

- This procedure is intended for empty containers only. Do not intentionally drain. Take all empty containers to RTV for processing.
- Supplies required: (1) large Ziploc bag, (1) universal absorbent pad (listed 4 ways), and a black marker. Pads can be ordered from ZCS: 877-253-3665 Part #454103.
- Carefully lift container over Ziploc bag to ensure it is empty.
- The Ziploc bag should contain no free liquid (use additional absorbent pads if necessary).
- Write the Costco Item Number on the Ziploc bag.
- Process through the bucket program according to Option 100.

SOP – Empty Containers (CA Only) 2 of 2

Standard Operating Procedure - Handling Empty Containers - CALIFORNIA ONLY

- Write “Empty” and the date on the container. Definition of an empty container.
- LA & SE Region Only: Place empty container into a fixed bin labeled “PLASTIC RECYCLING”.
- Bay Area Region Only: Place empty container in recycle bin.
- Recycling questions? Contact Todd Fitzgerald @ 425-427-3812 or tfitzgerald@costco.com

Handle through your approved recycler.
SOP’s – Battery Recycling

• All batteries in the hearing aid must be handled through the bucket program.
• All batteries are to be taped with 2” clear packing tape on both the positive and negative sides.
• Taped batteries are stored in the battery recycle pail. The lid must remain on the container at all times.
• You must label the container with the start accumulation date – this is the date you put the first battery into the pail.
• The pail must be taken to RTV on the 1st of every month and emptied into the appropriate bucket.

SOP’s – Used Hearing Aids/Accessories

Standard Operating Procedure – Used Hearing Aid(s) & Accessories

1. Tuck the electronic components in hearing aids, batteries, and any odd-shaped items into a standard size Ziploc bag and tie a black washer.
2. Record the equipment ID and the description of the equipment being disposed of on the Ziploc bag.
3. Place the used hearing aid(s) into the bucket, tie the bag, and close the bag.
4. The Ziploc bag must be stored in the bucket recycle pail. The hearing aid must be taken to RTV and properly disposed of on the first of each month.

If the equipment is not available, give the bag to a staff member for proper packaging and disposal.
SOP’s – Used Hearing Aid Receivers

Standard Operating Procedure – Used Hearing Aid Receivers

1. Tools you will need: 1 gallon size Ziploc bag and a black marker.
2. The disposal bin number 4672762 and description of the product being disposed of must be written clearly on the Ziploc bag.
3. Place the used receivers into the smallest Ziploc bag and seal the bag.
4. The Ziploc bag must be stored in the battery’s return pack. The receivers must be taken to RTV monthly with your batteries on the first day of each month. If the RTV box is not available, give the bag to an RPM level or higher manager for handling.

SOP’s – Used Impression Material Containers

Standard Operating Procedure – Used Impression Material Containers

1. Tools you will need: 1 gallon size Ziploc bag and a black marker.
2. The disposal bin number 604451 and description of the product being disposed of must be written clearly on the Ziploc bag.
3. Place two empty impression material containers into the smallest Ziploc bag and seal the bag. Bags must be taken to RTV daily at the time the hearing aid center closes.
4. The RTV clerk is not available, give the bag to a staff level or higher manager for handling.

“Mixed (Activated) impression material may be thrown into the trash.”
**SOP’s – Unused Impression Material**

**Standard Operating Procedure – Unmixed Impression Material**

1. Take the used impression material out of the package and place it into the designated container.
2. Write the date and time of disposal on the container.

**Unused Impression Material may be thrown into the trash.**

**SOP’s – Cetylcid II & Cavicide Disposal**

**Standard Operating Procedure – Cetylcid/Cavicide Handling Procedures**

1. Place the used items into the designated container.
2. Write the date and time of disposal on the container.

**Cavicide & Cetylcid Disposal**

**NOTE:** This process must happen immediately. (Refer to Infection Control Procedures page 3.)
SOP’s – Sporox II Disposal (OR Only)

THE OUTER EAR

Lesson 6
The Human Ear

- Critically important for the proper fitting of a hearing instrument!
- Curves and convolutions of the pinna collect and funnel acoustic energy into the ear canal.
- Cartilage covered with skin
  - Cartilage may be extremely stiff and rigid to soft and malleable.
- Which features of the pinna are critical for fitting hearing aids?
- Why?

The Pinna (aka The Auricle)
Sound Localization

• While one might think that the pinna has a role in sound localization, it does not when it comes to side to side localization.
• Side to side localization is a factor of the right ear vs. left ear comparison of intensities.
• Pinna is a factor for front to back localization.
  – This is why many manufacturers have a “pinna effect” added to the gain of the hearing aid.

Ear Canal (aka External Auditory Meatus)

• Typically curved like an “S” lying on its side.
• In adults it rises slightly upward, then slightly forward and downward toward the TM.
• Outer portion is cartilaginous, Inner portion is bony.
• Lined with skin
  – Outer portion contains hairs, wax-producing ceruminous glands, and sebaceous (oil) glands.
• Normally self-cleaning.
  – Ear debris migrates outward from the TM while the hairs gently and constantly move dry particles of cerumen and sloughed skin into the concha bowl.
Ear Canal

• Normal ear canal varies in size, length, width, and direction
  – Length varies from \( \frac{7}{8} \) of an inch to 1 \( \frac{1}{8} \) of an inch - average is 1 inch.
  – Averages \( \frac{3}{4} \) inch in diameter
• Isthmus - an area approx. \( \frac{3}{4} \) way between the aperture and TM where the canal becomes narrow.
  – Isthmus is located just past the second bend.

• Why is the isthmus an important anatomical feature for the fitting of hearing aids?

Outer Ear Resonances

Two outer ear resonances that are important considerations for every hearing instrument fitting.
• The concha has a resonant frequency of 4000 to 5000 Hz.
  – It adds 5 to 8 dB of intensity when stimulated with ambient sound around those freq.
• Most adult ear canals resonate between 1500 and 4000 Hz with an average resonant frequency of about 2700 Hz and an average gain of 16dB.
Vagus Nerve (Xth Cranial Nerve)

A branch of the vagus nerve lies along the bottom of the canal between the aperture and the isthmus.

When touched in can result in an automatic cough known as Arnold’s Reflex.

This cough is normal and does not indicate a problem.

- Why is the Arnold’s Reflex important to hearing aid fittings?
- When should you alert a member about Arnold’s Reflex?

Tympanic Membrane (aka TM, aka Eardrum)

- Dividing line between the outer ear and the middle ear.
- Anatomically the TM is part of the outer ear.
- Physiologically it is classified as part of the middle ear.
- Oval in shape.
- Normal color range is translucent pearly white to pinkish gray.
- Middle ear structures can often be seen behind it.
• It is about ¼ inch high, ⅜ inch wide.
• Three layers
  – Skin of ear canal
  – A tough fibrous layer that has two components.
    • It is made up of fibers arranged like the spokes of a wheel as well as fibers arranged in concentric circles. Together they form an extremely strong grid that gives this layer strength and durability under pressure.
    – A mucous membrane which is continuous with the lining of the middle ear cavity.
• The annulus or annular ring holds the TM in place forming a watertight and airtight seal between the external and middle ear.

• Acoustic energy, enhanced by pinna and ear canal resonances, cause the TM to move back and forth in response to the vibrations.
  – Vibrations are transmitted to the malleus in the middle ear, which is attached from the top of the TM to a point about ⅔ of the way down.
  – Umbo - the point where the tip of the handle of the malleus attaches.
    • The TM is pulled in toward the middle ear at this point and is also the point where the greatest retraction occurs.
• Most of the TM is stretched tightly and is called the pars tensa.
  – The upper area is loose and more flaccid because it lacks the fibrous layer and is called pars flaccida.
Light from an otoscope that reflects from the umbo to the bottom of the TM.
TM Quadrants

• Top ½ = Superior, Bottom = Inferior
• Back = Posterior, Front (Nose) = Anterior
• Combinations of descriptions can be created to allow for more precise locations and to accurately communicate the area of concern.

Where is the curser?

• Right TM
• Superior-Posterior
Where is the curser?

- Right TM
- Anterior-Inferior

Where is the curser?

- Left TM
- Anterior-Superior
Where is the curser?

- Left TM
- Posterior-Inferior

Lesson 7

DISORDERS OF THE OUTER EAR
Disorders - Atresia

- Absence or abnormal narrowing of an opening or passage in the body.
- A narrowing or closure of the auditory canal and a malformed or missing pinna.
- When present at birth is called “congenital.”

Disorders – Cerumen (aka Ear Wax)

- A common cause of what type of hearing loss?
- Normally cerumen moves outward to the entrance of the external ear canal.
- It can accumulate in the canal forming a plug which partly or completely blocks the canal.
- DO NOT test or fit a hearing instrument until the cerumen has been removed.
  - You must be able to see all four quadrants of the TM before testing or attempting an ear impression.
Disorders – Otitis Externa

- An inflammation of the walls of the external auditory canal.
- Eczema or dermatitis causes the pinna to be itchy and painful.
- Although testing can be performed if the canal is not blocked, the member should be referred to a physician.

Disorders - Polyps

- Masses of tissue that grow outward from a surface, in this case, the canal wall.
- Any polyp, lump, or bony growth is a cause for referral.
- Exostoses are growths in the external canal often caused by prolonged exposure to cold water, common to surfers, divers, and swimmers.
Disorders – Prolapsed or Collapsed Canal

- A breakdown or sag of tissue around the canal.
- Causes the canal to collapse, partially or completely blocking the external canal.
- The canal can be opened by lifting the pinna upward and backward.

Disorders - Perforations

- Perforations are holes in the TM.
- Causes can be:
  - Middle Ear Infection, cholesteatoma, damage from a foreign object, etc...
  - Small perforations may cause a 10-15dB loss in hearing sensitivity.
  - Small holes can often heal spontaneously within a few weeks.
  - A larger perforation requires a surgical technique called tympanoplasty or myringoplasty to patch the hole.
Disorders – Monomeric Spots

- The result of holes that have healed without the fibrous layer.
  - May look like TM perforations.

Disorders – TM Scarring

- Can result from healed perforations or recurrent middle ear infections.
Disorders - Tympanosclerosis

- A hardening of the TM caused by calcium deposits.
  - Appears opaque, white, and chalky.

Foreign Objects in the Ear Canal
**Medical Referrals**

**Hearing Instrument Specialists**

Remember that as Hearing Instrument Specialists we are not allowed to diagnose or state the cause of hearing impairment.

**We can state and describe what we see.**

For our outcome notes we can state that an audiogram *indicates* that a member has a type of hearing loss.

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**Medical Referrals**

- Every time that you tell a member that they should see a physician, for any reason, you need to document that with both an outcome note and a Costco Physician Referral Form signed by both you and the member.
Medical Referrals

When making a referral based on otoscopic results the phrase “Member has what appears to be...” is a handy way to begin the description of what you see.

Again...

We state and describe what we see.

We NEVER diagnose.
Types of Hearing Loss

- **Conductive** - results from abnormalities of the external and/or middle ear. Sound is not readily transmitted or conducted through air, bone, or tissue because of the abnormality.

- **Sensory/neural** - results from damage to the inner ear and/or auditory nerve

- **Mixed** - a combination of conductive and sensory/neural

- **Central** - the inability of the brain to process, recognize, or understand sounds or speech accurately.

- **Functional** - non-organic. It is evident when a person is not or cannot be truthful or accurate in their responses during hearing testing. Nothing is physically wrong with the person’s hearing mechanism.
Sensory/Neural

Mixed
Questions...

- What types of hearing loss would indicate that a medical intervention may provide improvement?
- Which types of hearing loss can be helped with amplification?
- Which types of hearing loss is amplification not recommended for?

Medical Referral for Audiometric Considerations

- When is it appropriate to make a medical referral based on audiometric results?
- How would you write up a medical referral for a conductive or mixed loss?
The middle ear is a mucous membrane-lined, air-filled space that lies within the petrous portion of the temporal bone.

It contains three tiny bones with their ligaments, two muscles, the opening of the Eustachian tube, the oval window and the round window.

Branches of several nerves travel through the middle ear.
The Middle Ear

- The ossicles are the smallest bones in the human body.
- Common Names: Hammer, Anvil, and Stirrup
- Latin Names: Malleus, Incus, and Stapes
  - The bones are suspended by ligaments and are loosely connected to each other to form a linkage - the ossicular chain.
  - The manubrium, or handle, of the malleus is attached to the TM.
  - The footplate of the stapes is held in the oval window by an annular ligament.
The Middle Ear as a Transducer

Transducer - a device that changes power/energy from one form to another.

Middle ear transduces acoustic energy received at the TM to mechanical energy in the ossicular chain and the stapes footplate transduces mechanical energy from the ossicular chain to hydraulic energy in the inner ear.

Impedance Matching or Transfer Function

• Air has a low impedance, fluids have a very high impedance
  – Normally this mismatch would cause a decrease in sound pressure level as the acoustic energy traveled through the two mediums.
• Impedance matching increases the sound pressure in 3 ways:
  – There is an areal difference between the areas of the TM and the oval window
    • The TM is roughly 14 times the size of the oval window
  – The ossicular chain acts as a lever in increases the sound pressure 1 ½ times as the energy is transferred through the ossicles
    • This creates an increase in the sound pressure at the oval window of approx. 27 dB.
  – The back and forth motion of the TM which creates an additional increase of sound pressure of 10dB.
• Total gain of approx. 36 dB passed to ME!
Middle Ear Cavity

- **Function of ossicles**
  - 99.9% sound is reflected due to high impedance of fluid in the cochlea (0.1% sound is only passed = -30 dB sound loss from air - fluid impedance mismatch)
  - Middle ear bones overcome the loss of sound by increasing sound pressure (+34dB)
  => Impedance matching

Middle Ear Muscles

- Smallest muscles in the human body
- Tensor tympani attaches to the handle of the malleus
- Stapedius attaches to the neck of the stapes
- Purpose:
  - To keep the bone linkage taut so that it can respond efficiently to vibrations
  - To contract to prevent extreme motions of the linkage which might result in inner ear damage from very loud sounds
Acoustic Reflex

• When a loud sound from the outer ear is received by the middle ear, the tensor tympani and stapedius muscles contract, causing the ossicular chain to stiffen.
  – When the stapedius contracts in one ear, it also contracts in the other.
• The measurement of the acoustic reflex is called Tympanometry.
  – It can be measured ipsilaterally (same side)
  – It can be measured contralaterally (opposite side)

Oval and Round Windows

• Oval window is an opening in the bone between the air-filled middle ear and the fluid-filled inner ear.
  – It is covered by a thin membrane
  – The footplate of the stapes is set in the oval window over the membrane and both are sealed in the window by the annular ligament.
  – Sound is transmitted from the ossicular chain to the inner ear fluids through this window.
• Round window is also a membrane-covered opening in the bone, separating the middle and inner ear.
• The oval and round windows are separated by a bony prominence called the promontory.
Eustachian Tubes

- Connect the middle ear cavity to the nasopharynx.
  - Nasopharynx provides a direct connection for outside air to enter the middle ear space.
- Maintains equal pressure and allows healthy air to enter the middle ear space
• Children
  – Have straight, short, horizontal, relatively open Eustachian tubes
  – Germs can readily pass from the nasopharynx to the middle ear causing infections
  – Since the tubes are horizontal, fluid drainage is not always possible
• Adults
  – Have longer, arched, downward-slanting Eustachian tubes
  – They are about 1 ½ inches long and are normally closed - which prevents infection
  – In adults they open during a cough, sneeze, or swallow - which allows air to travel from the outside to the inside and equalize middle ear pressure with atmospheric pressure.

What’s Next?

• Lessons 9 – 13
• Costco U Quizzes
• IHS Quizzes
• Portfolio Assignments from costcohaap.com
• Flashcards!!!!!
• Observe your Mentor – Get in the Booth.
References

