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Development of a Pediatric Balance Center: A Multidisciplinary Approach

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Katheryn Bachmann, PhD

Katheryn "Kay" Bachmann, Ph.D. has been an audiologist for 27 years and is currently the Coordinator of Research for the Pediatric Balance Center at Cincinnati Children's Hospital Medical Center. She attended Miami University (Ohio) as an undergraduate and earned her M.S. from the University of Akron before earning her PhD from Vanderbilt University. Dr. Bachmann specializes in the evaluation of dizziness and balance disorders in children, both clinically and through her research at Cincinnati Children's. She has co-authored a number of articles and book chapters in the area of pediatric hearing and balance and has given numerous presentations in her career. Dr. Bachmann is also an adjunct assistant professor at the University of Cincinnati, where she advises student capstone projects and teaches the vestibular courses to AuD candidates.



Violette Lavender, AuD

Violette is the coordinator for the Pediatric Balance Center at Cincinnati Children's hospital and helped initiate the program. She has been a clinical audiologist for 16 years and specializes in disorders of the pediatric vestibular system. She also is instrumental in the treatment of children with hearing loss. She has co-authored articles and book chapters and has given presentations locally and nationally in the area of vestibular disorders in children. Violette graduated from Purdue University with her Master's in Audiology and earned her AuD from the University of Florida.





- **Presenter Disclosure:** Katheryn Bachmann: Financial: Katheryn Bachmann is employed by the Pediatric Balance Center at Cincinnati Children's Hospital Medical Center. She received an honorarium for this presentation. Non-financial: Katheryn Bachmann is a reviewer for JAAA; Co-author of Standard Practice Document for Pediatric Vestibular Assessment

 Violette Lavender: Financial: Violette Lavender is employed by the Pediatric Balance Center at Cincinnati Children's hospital. She received an honorarium for this presentation. Non-financial: Violette Lavender is the Co-author of Standard Practice Document for Pediatric Vestibular Assessment.
- **Content Disclosure:** This learning event does not focus exclusively on any specific product or service. The development of the Cincinnati Children's Hospital Multidisciplinary Pediatric Balance Center will be discussed.
- **Sponsor Disclosure:** This course is presented by Seminars in Hearing, a publication of Thieme Medical Publishers, in partnership with AudiologyOnline.



Learning Outcomes

After this course, participants will be able to

- Identify three key team members that make up a multidisciplinary pediatric balance center.
- List at least two potential referral sources for pediatric balance evaluation and treatment.
- Justify the need and determine the realistic potential of developing a multidisciplinary pediatric balance center.



Challenges to starting a pediatric balance program



Who will be involved in evaluating and treating patients?

How do I gain support for developing a pediatric balance center?

What equipment is needed? Cost? Space?

Who will refer patients?

How do I advertise?

What will the reimbursement be?

How do I bill for services?



Who is my business manager?



Knowing the Facts

Common Beliefs

1. Children do not get dizzy.
2. Even if they did, they compensate!
3. Children won't cooperate, the test is too scary.
4. What are the norms?



Knowing the Facts

- Testing children for vestibular dysfunction is NOT a new concept
 - 1980's – David Cyr
 - 1990's – Sylvette Viener Wachter
 - 2000's – Maureen Valente
- The literature is growing!
 - Incidence – how big is the problem?
 - Specific testing techniques with children
 - Normative data reported
 - Awareness of pediatric vestibular loss is on the rise



Knowing the Facts

- Prevalence:
 - 1%-5% in general population
 - 30% - 70% of children with SNHL have co-existing vestibular loss
- Under-reported
 - Children lack vocabulary to express feelings of imbalance
 - Not aware that dizziness and imbalance is not normal
 - Parents may dismiss signs of vestibular dysfunction as the child being “clumsy”



Rationale for Testing Children

- To help determine site of lesion
- To determine course of treatment
- To rule out more significant diagnosis
- To help with choice of sides for CI's
- To alleviate fears for families
- Children have ADL's that are much different from adults



Symptoms of Vestibular Dysfunction in Children

- ~~■ Complaints of vertigo~~
- ~~■ Difficulty driving~~
- ~~■ Unable to go to work~~
- ~~■ Rearing tinnitus~~
- Behind learning to sit
- Behind learning to walk
- Falling/Bumping into things
- Difficulty with reading acuity
- Not keeping up physically with their peers
- Other issues: **Cognitive? Academic? Mental health?**



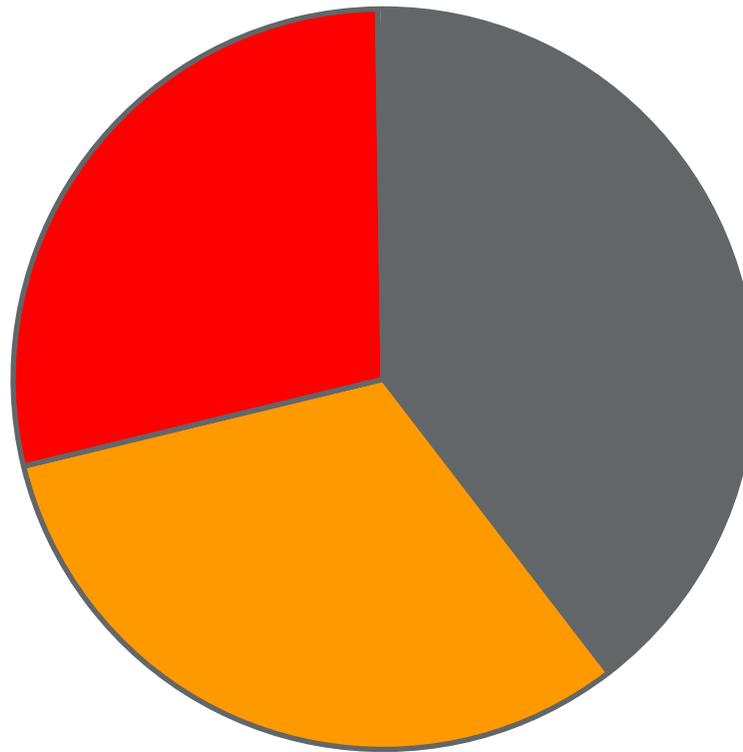
Who Is At Risk for a Vestibular Disorder?

- Cochlear Malformations (EVA, Partitioning defects, common cavity, Mondini)
- Cytomegalovirus
- Cochlear Implant patients (pre and or post CI)
- Syndromes (Waardenburg, Usher's, Pendred, etc)
- VIII Nerve Defects ("wispy nerve", absent nerve, ANSD)
- Ototoxicity-Vestibulotoxicity (CF)
- Head Trauma (Sports related or accidental)
- Migrainers



n=417

By Diagnosis 2016-2020



■ Central

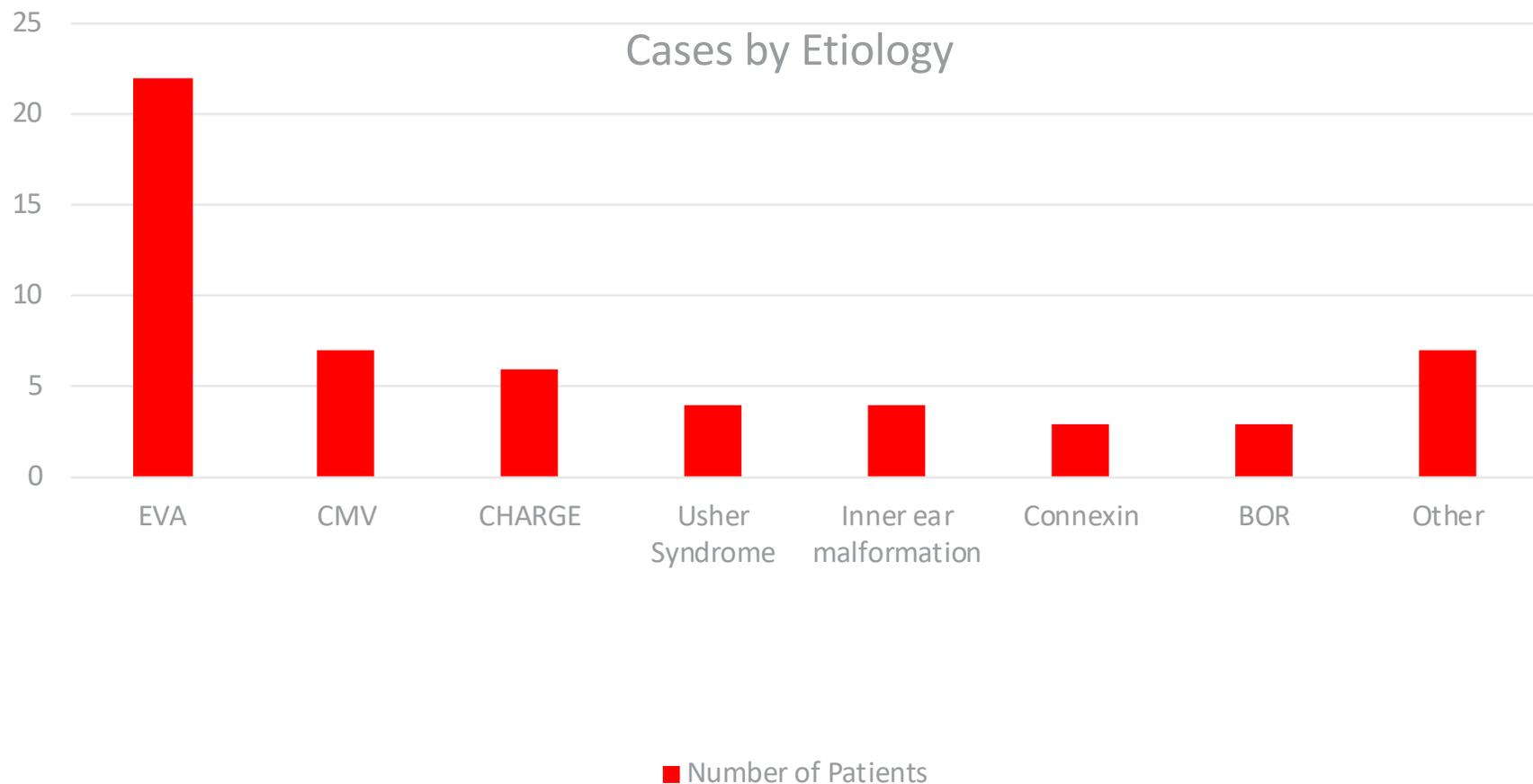
■ Normal

■ Peripheral

■ Undetermined



Etiology N=56
(of 105 patients with hearing loss)





Knowing the Facts

- Children with vestibular loss were thought to compensate on their own due to neural plasticity
 - Latest research (Janky and Givens 2015):
“Children with vestibular loss do not naturally recover to levels of their healthy peers, particularly with activities that utilize vestibular input and attention should be given to vestibular loss in the pediatric population.”



What can we do for these children once they are found to be at risk for a vestibular disorder?

Programmatic Vestibular Rehabilitation

Shepard, N. T., & Telian, S. A. (1995). Programmatic Vestibular Rehabilitation. *Otolaryngology–Head and Neck Surgery*, 112(1), 173–182. <https://doi.org/10.1016/S0194-59989570317-9>

Improvement of motor development and postural control following intervention in children with sensorineural hearing loss and vestibular impairment

Rine, M.S., et.al. (2004). Improvement of motor development and postural control following intervention in children with sensorineural hearing loss and vestibular impairment. *Int Journal of Pediatric Otorhinolaryngology*, 68(9), 1141–48. <https://www.sciencedirect.com/science/article/abs/pii/S0165587604001181>.

Role of vestibular adaptation in vestibular rehabilitation

Herdman, S. J. (1998). Role of vestibular adaptation in vestibular rehabilitation. *Otolaryngology–Head and Neck Surgery*, 119(1), 49–54. [https://doi.org/10.1016/S0194-5998\(98\)70195-0](https://doi.org/10.1016/S0194-5998(98)70195-0)

Effect of an Exercise Program on the Static Balance of Deaf Children

Susan K Effgen, MMSc, Effect of an Exercise Program on the Static Balance of Deaf Children, *Physical Therapy*, Volume 61, Issue 6, 1 June 1981, Pages 873–877, <https://doi.org/10.1093/ptj/61.6.873>



Key Players and Their Roles



Key Players and Their Roles





Teamwork for Healthcare

*“A **dynamic process** involving two or more health professionals with **complementary backgrounds and skills**, sharing common health goals and exercising concerted physical and mental effort in assessing, planning, or evaluating patient care. This is accomplished through **interdependent collaboration**, open communication and **shared decision-making**.*

This in turn generates value-added patient, organizational and staff outcomes.”

Xyrichis A, Ream E . (2008). Teamwork: a concept analysis. *J Adv Nurs*. 61(2):232-41.



Multidisciplinary Pediatric Vestibular Team – Cincinnati Children’s Hospital



Katheryn Bachmann, PhD



Violette Lavender, AuD



Micheal Castiglione, AuD



John Greinwald, MD



Gretchen Mueller, DPT



Ashley Cabrera, DPT



Kim Yungbluth, DPT



Key Players and Their Roles

- Audiologists
 - Diagnostic evaluations
 - Knowledge/training in vestibular assessment & diagnosis
 - Specialists working with children
- One designated audiologist
 - Guides the patient through the multidisciplinary process
 - Assists in coordination of appointments
 - Contact person for family to answer questions
 - Coordination of the team
 - Schedules and Leads team meetings
 - Follows up with family following team meeting



Key Players and Their Roles

- Physician
 - Knowledgeable about vestibular pathology & treatments
 - Manage patient's medical care
 - Pharmacological and medical intervention
 - Uniquely qualified to make additional referrals
 - Psychology
 - Neurology
 - Physical or Occupational Therapy

Open communication with the physician is
key to the success of the program!



Key Players and Their Roles

- Physical Therapists
 - Specialists in vestibular rehabilitation
 - Uniquely qualified to evaluate patient to determine primary cause of balance dysfunction
 - Musculoskeletal problems
 - Vestibular dysfunction
 - Other motor dysfunction
- Specific training courses for PTs and OTs
 - Didactic lecture and hands-on training



Key Players and Their Roles

- Additional Support Staff
 - Dedicated individual or team of individuals
 - Triage patient needs through the scheduling center
 - Check referrals
 - Coordinate same day appointments
 - Important for those traveling from a distance
 - Manage follow up appointments and referrals

Right hand helper to the coordinating audiologist



Space

- Identifying space is key first step.
- Large grants and donations as equipment is expensive
- Space comes at a premium in a large medical center.
- In our program,
 - span three different divisions
 - space overlaps PT/audiology



Physical Needs of a Pediatric Balance Center

- Space

- Minimum Space Requirements

- Room should accommodate

- Chair that can recline & also rotate

- Rolling cart for laptops & other equipment

- Caloric irrigator

- vHIT goggles

- VEMP electrode box

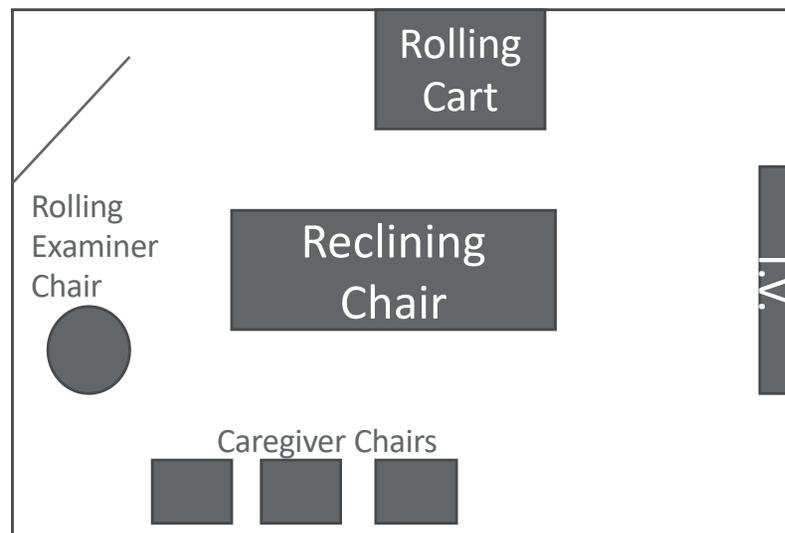
- Can mount T.V./computer monitor on the wall





Physical Needs of a Pediatric Balance Center

- Space
 - Minimum Space Requirements
 - Room should accommodate
 - *Several chairs for seating of multiple caregivers or family members





Pictures of Clinics:



Photo Cred: Kristen Baisley, Rady Children's; Melissa Caine, CHOP



Equipment



Rotary Chair

- Ages: Birth and up
- Test: Overall VOR function in lateral canal plane
- Limitations:
 - Not ear specific
 - difficult for objective data in very young (but could use electrodes)
- Costs: \$90,000-180,000





Rotary Chair

Infants and Toddlers

- In room camera, for qualitative assessment.
- Use of 5-point car seat secured in chair.
- Allow for snacks and favorite toys, blankets during test for comfort.
- Parents can stand in enclosure with child, or have child sit on their lap.

Children 2½ to 5 years

- Smaller goggles available.
- Use of a booster seat/car seat.
- Allow child to hold sensory type toy (bean bag toy, vibrating toy, light up toy) if fidgeting and for distraction between rotations.



Vestibular Evoked Myogenic Potentials

- Ages: birth and up
- Test: Utricle and Saccule pathways to motor neurons on neck and ocular motor muscles
- Limitations: oVEMP requires some participation, electrodes may be imposing to children
- Costs: \$14,000-24,000





Vestibular Evoked Myogenic Potentials

Infants and Toddlers

- Seat child facing parent on parent's lap and lay child back.
- Instinct will be to try and sit up to get to parent.
- Use motivational toys or snacks for the child to reach for.

Children 3 and up

- Use of cartoon that plays when child holds correct neck contraction.
- Use of “fun” visual to elicit cooperation and head turn- bubbles, videos, positioning on parents lap, toys for distracting.
- Consider measuring only presence or absence.
- Use phone or iPad target video for oVEMPS



Videonystagmography

- Ages: typically 5 and up
- Test: Calorics test ear specific lateral canal and pathway; positionals look at central and peripheral nystagmus, Dix-Hallpike for BPPV; Ocular motor testing for brain/eye pathway
- Limitations: Difficult for young children to keep eyes open or complete calorics
- Costs: \$20,000-40,000





Videonystagmography

- Manufacturers have goggles fitting ages 3 and up.
 - Normative data available in the literature for most subtests.
- Be cautious of pupil tracking algorithm



Video Head Impulse Test

- Ages: 3 and up
- Test: high frequency VOR function for all 6 canal planes
- Limitations: goggle slippage on little heads, no pediatric goggle marketed (although no-touch options in Europe look promising)
- Costs: \$9,000-20,000



Video Head Impulse Test

- Use of a small sticker of child's choice
 - Consider switching sticker often for better attention throughout testing
- Horizontal canal testing most reliable in young ones
- Normative data
- Other Adaptations:
 - Sit on parent's laps
 - Use of foot stool or sitting “criss-cross” for stabilization
 - Use video on phone as target
 - Use foam/wash cloth or low ponytail to hold goggles in place



Posturography

- Ages: 3 and up
- Test: Overall balance function, subdivided into senses.
- Limitations: Not exactly site specific, Static balance only
- Costs: \$75,000-90,000





Posturography

- Easy to test children
- Normative data in software to 3 years old for SOT
- Nice functional test of balance.



Vestibular Rehab Tools

- Standardized tests (BOT-2, PDMS-2nd Edition, Motion Sensitivity Quotient, Dynamic Gait Index, etc.)
- Balance Tools (Rocker board, Stepping Stones, bikes, etc.)
- Objective tests (Computerized Dynamic Visual Acuity, Posturography)



Questionnaires

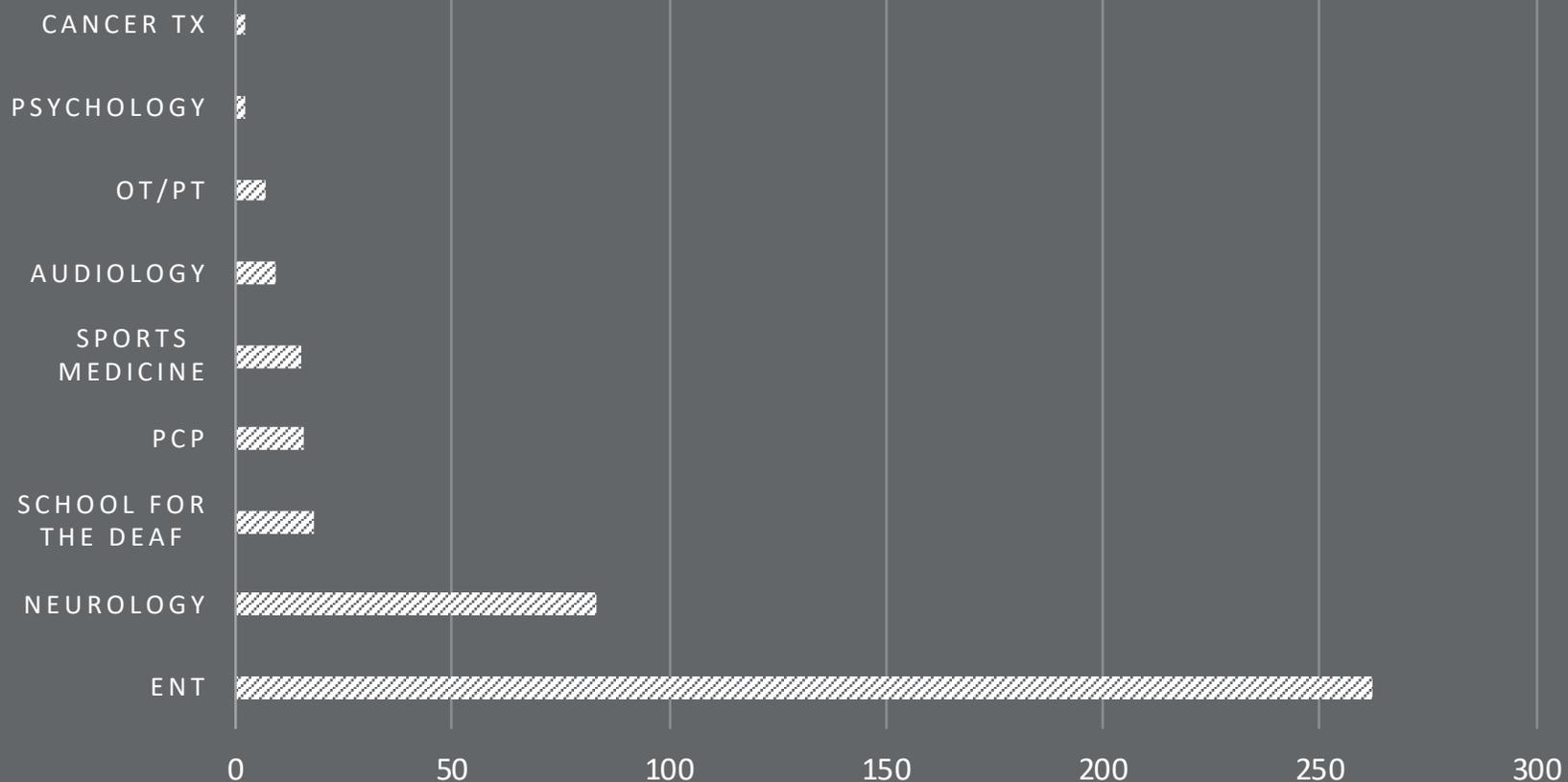
- Pediatric Dizziness Handicap Inventory for Patient Caregivers
 - ages 5–12
- The Pediatric Vestibular Symptom Questionnaire
 - ages, 6–17
- Ages and Stages
 - birth to age 6



Referrals



REFERRAL SOURCES, CCHMC 2016-2020





Building Referral Sources

- Building Relationships
- Education
 - Schools
 - Internal departments
 - Pediatricians
 - Local ENTs
 - Administrators
- Vestibular Screenings –
 - local school for children with hearing loss
 - Single Leg Stance, Milestones
- Flyers/ Website





Pediatric Balance Center

Our Balance Center offers a team-oriented approach to diagnosing and treating disorders of the pediatric vestibular (balance) system. Children may be born with or may acquire a vestibular disorder – a disruption of the cues provided by the inner ear, the eyes and the feet (proprioception) – that affects balance.

Contact us
Call 513 803 9630 with direct questions for an audiologist.

For additional questions, contact us through the Physician Priority Link: 513-636-7997 or 888-636-7997.

5.3%
of children experience dizziness and balance problems

Spectrum of Care – Conditions Treated

- Dizziness or lightheadedness
- Spinning sensation (vertigo)
- Sensorineural hearing loss
- Inner ear anomalies
- Migraine with dizziness
- Motor delays
- Difficulty walking
- History of ototoxicity (from medication exposure)
- Motion sickness
- Head injuries
- Frequent unexplained falls
- Gait disturbances

Why Refer to Us?

Our multidisciplinary Balance team works together to evaluate and prescribe the most appropriate treatment for your patient. This collaboration directly involves:

- Otolaryngologist – diagnoses and treats the balance disorder and refers for appropriate testing
- Audiologist – performs the hearing and balance assessments
- Physical therapist – completes a sensory motor evaluation, which includes sensory processing, oculomotor and self-help skills assessments

We may also include specialists in neurology, oncology, psychology, and neurosurgery in your patient's balance assessment if needed.

Treatment Team

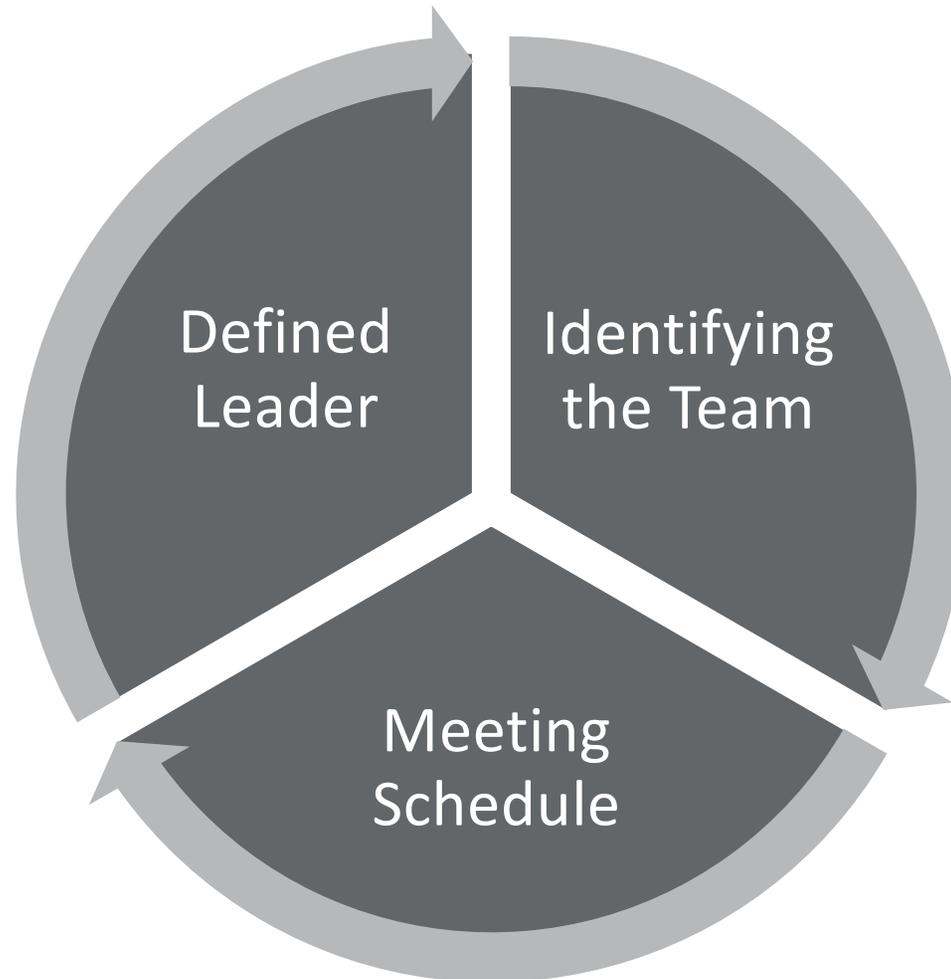
<p>Otolaryngology Team Daniel Choo, MD John Greinwald, MD</p>	<p>Physical Therapy Team Ashley Cabrera, PT, DPT Gretchen Mueller, PT, DPT Kimberly Yungbluth, PT</p>
<p>Audiology Team Katherin Bachmann, PhD Micheal Castiglione, AuD Violette Lavender, AuD</p>	



Logistics/ Implementation



Preparing To Open



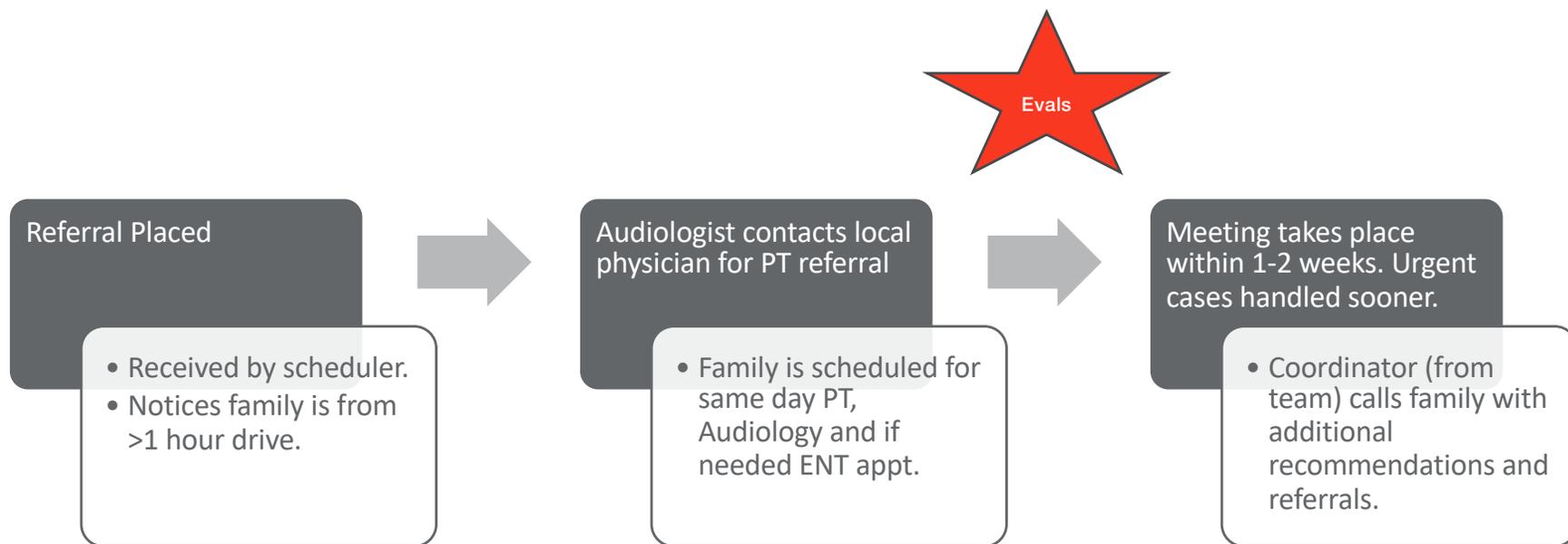


Preparing to Open

- Normative Data Collection
- Order lots of prizes and stickers for motivation
- Find co-workers who can have energy for 2 hours at a time!
- Team testing

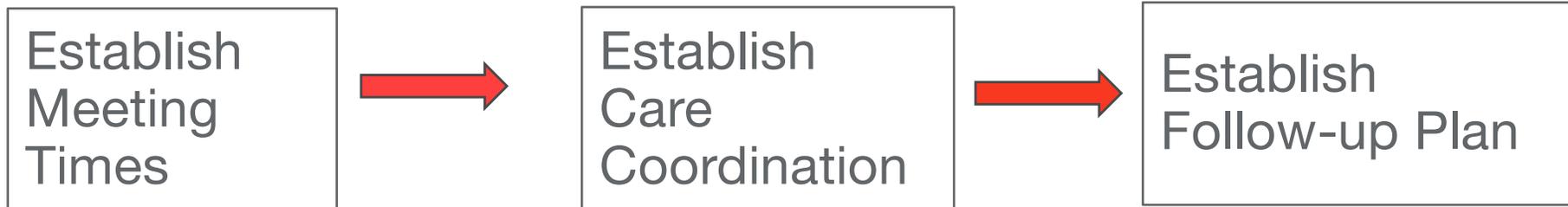


Following the Family





Meetings



- All team members should agree on a regular time, day, method and frequency of meetings
- Multidisciplinary layers to add intelligent conversation to diagnosis path
- One team member should lead the meeting, providing an agenda and list of patients to be discussed prior to the meeting
Important for delivering plan of care
- The team leader should be responsible for contacting the family with any changes to treatment or recommendations based on the outcome of the team meeting.
- Important for success as a team to check in



Questions?

- Katheryn.Bachmann@cchmc.org
- Violette.Lavender@cchmc.org



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