Considerations for Dose Delivery Devices Intended for Pediatric Population

Tianyi Zhang, PhD
Human Factors Reviewer
Division of Medication Error Prevention and Analysis I (DMEPA I)
Office of Medication Error Prevention and Risk Management (OMEPRM)
Office of Surveillance and Epidemiology (OSE)
Center for Drug Evaluation and Research (CDER)

Disclaimer

This presentation reflects the views of the author and should not be construed to represent FDA's views or policies.

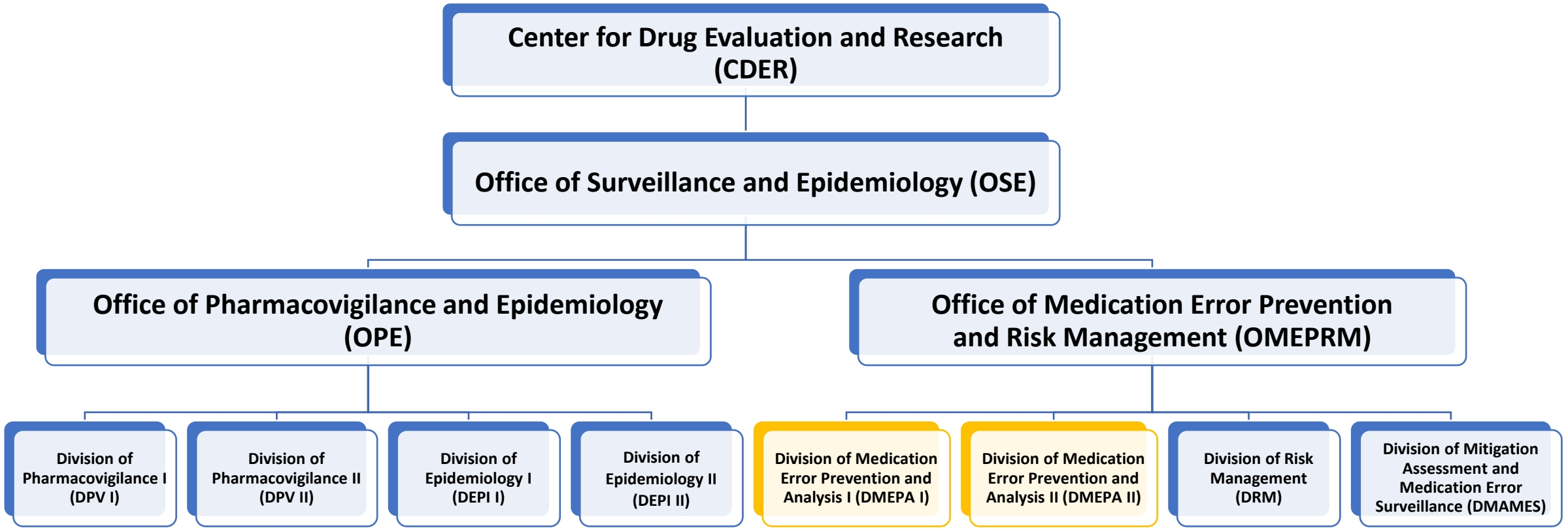
Reference to any marketed products is for illustrative purposes only and is not to be construed as either an actual or implied endorsement of such products by the U.S. Government, the Department of Health and Human Services, or the Food and Drug Administration.

Agenda

- Brief Overview of the Division of Medication Error Prevention and Analysis (DMEPA)
- Human Factors Considerations When Designing Dose Delivery Devices Intended for Pediatric Population
- Importance of Conducting Human Factors Validation Studies (HFVS) with Pediatric Participants
- Considerations for Conducting HFVS with Pediatric Participants

Overview of DMEPA

Who Is DMEPA?


Center for Drug Evaluation and Research (CDER)
Office of Surveillance and Epidemiology (OSE)
Office of Pharmacovigilance and Epidemiology (OPE)
Office of Medication Error Prevention and Risk Management (OMEPRM)
Division of Pharmacovigilance I (DPV I)
Division of Pharmacovigilance II (DPV II)
Division of Epidemiology I (DEPI I)
Division of Epidemiology II (DEPI II)
Division of Medication Error Prevention and Analysis I (DMEPA I)
Division of Medication Error Prevention and Analysis II (DMEPA II)
Division of Risk Management (DRM)
Division of Mitigation Assessment and Medication Error Surveillance (DMAMES)

Who Is DMEPA?

- Created in 1999.
- CDER Lead for *premarket* medication error prevention and analysis for drug and therapeutic biological products.
- Evaluates weekly surveillance reports of medication errors submitted to the FDA Adverse Event Monitoring System (AEMS).
- Scientists and healthcare professionals with varied backgrounds.

DMEPA Mission Statement

To increase the ***safe use*** of drug products by minimizing use error that is related to the ***naming, labeling, packaging, or design*** of drug products.

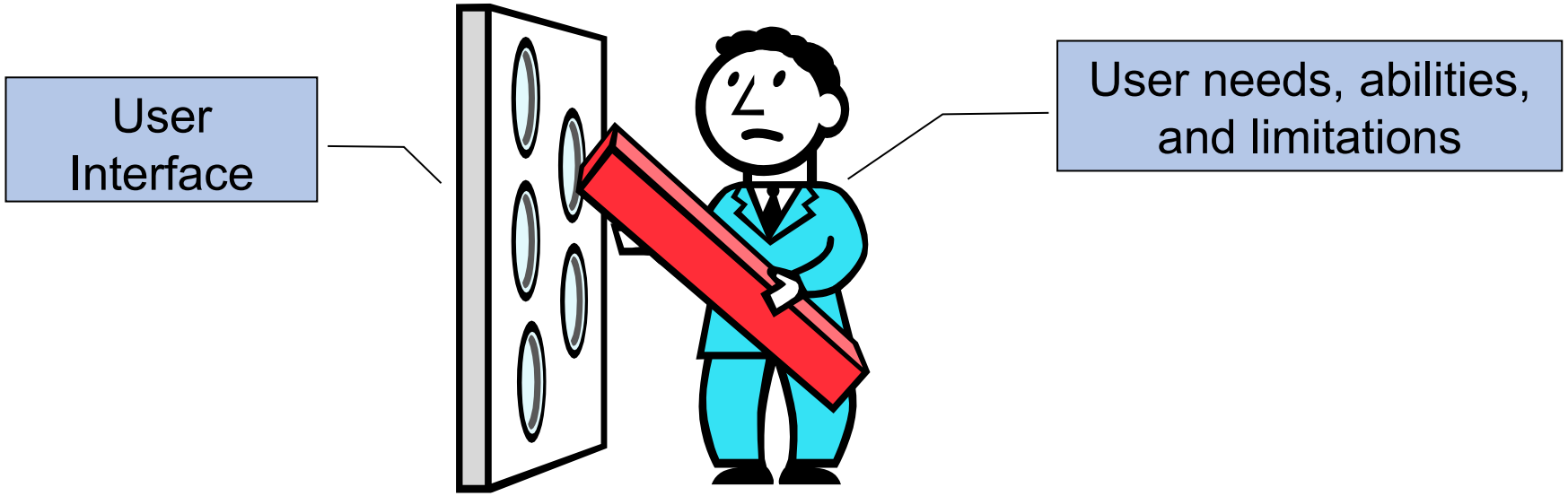
What Does DMEPA Do?

- Proprietary Name Review (PNR)
- Nonproprietary Name (NPN) Suffix
- Labels, Labeling, Packaging
- Human Factors (HF)
- Formal meeting packages
- Citizen Petitions/Suitability Petitions
- Medication Error Surveillance Reports (MESRs)
- Guidances/MAPPs/SOPs/SMGs
- Research Activities

Human Factors Considerations When Designing Dose Delivery Devices Intended for Pediatric Population

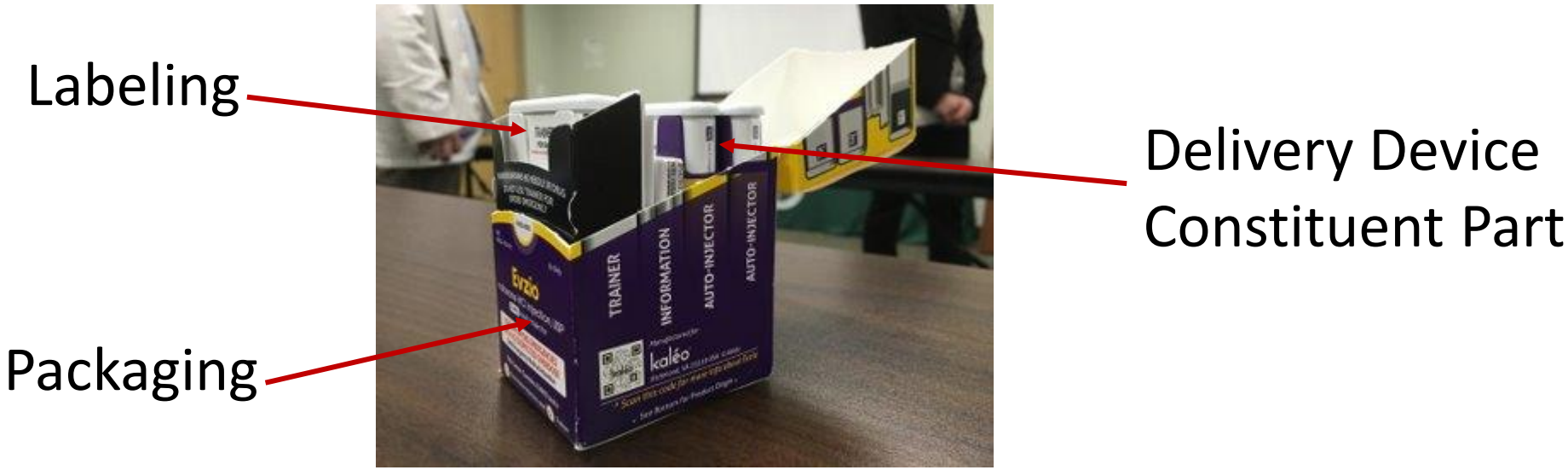
What Is Human Factors?

- "The application of knowledge about human behavior, abilities, limitations, and other characteristics of medical device users to the design of medical devices including mechanical and software driven user interfaces, systems, tasks, user documentation, and user training to enhance and demonstrate safe and effective use."
  – Guidance for Industry and Food and Drug Administration Staff *Applying Human Factors and Usability Engineering to Medical Devices* (February 2016)



User Interface

- NOT just the device!
- Includes **all** points of interaction between the product and the user(s):
  - Product (e.g., drug/biologic-device combination product)
  - Packaging (container closure)
  - Labels (Instructions for Use (IFU), container label, and carton labeling)



Oral Dosage Forms That May Be Used in Pediatric Patients

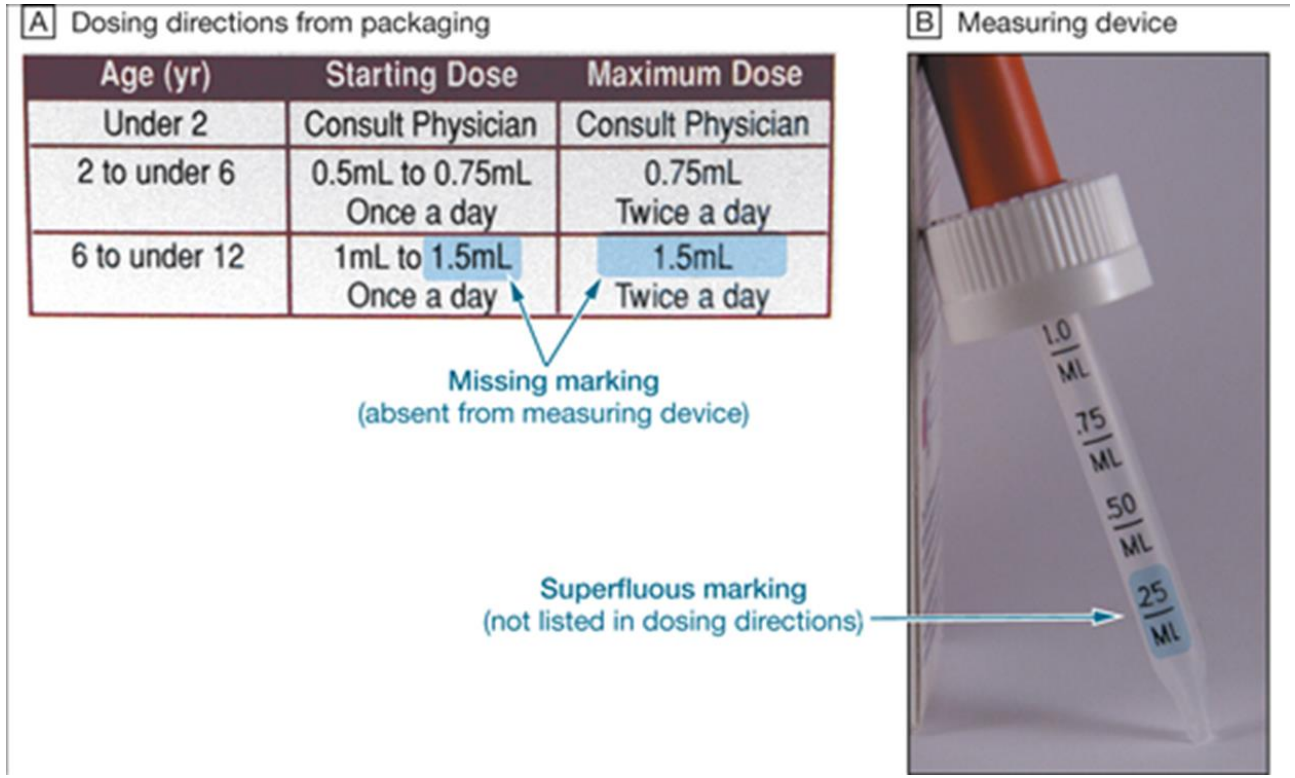
- Examples of oral dosage forms: tablet for oral suspension, oral solution, oral granules, sublingual films.
- Product design considerations:
  - Oral “liquid” rather than tablet for oral suspension.
  - Concentration/strength and the liquid volume for the intended dose.
  - Balancing palatable vs. “yummy” (risk of candy-like taste).
  - Appearance (risk of rainbow-colored mini tablets, “gummy bear” shape).
- Packaging design consideration:
  - Risk of container closure that are visually attractive to kids (e.g., animal shape).

Oral Dose Delivery Device for Pediatric Patients

- Consider the appropriate dose delivery device for the prescribed dose.
  - Oral syringes over cups for smaller volumes.[1]
- Consider the appropriate dose delivery device size for the prescribed dose.
  - If 10 mL dose volume, select 10-mL oral syringe over 1-mL oral syringe.
  - If varying dose volume, consider if an appropriate size can be co-packaged vs. provided by dispensing pharmacy.

Oral Dose Delivery Device for Pediatric Patients

- Limit the markings on the dose delivery devices to those that correspond to the dose(s) to be administered.



http://jama.jamanetwork.com/article.aspx?articleid=187072

Injection Dosage Form That May Be Used in Pediatric Patients

- Examples of Injectable presentations: vial, autoinjector (AI), prefilled pen (PFP), prefilled syringe (PFS).
- Product design considerations:
  - AI/PFP/PFS rather than vial.
  - Concentration/strength and the injectable volume for the intended dose.
    - Is the injection volume appropriate for subcutaneous injection?
  - Needle length and gauge.[2]
    - Route of injection: intramuscular or subcutaneous
    - Site of the injection
    - Age: neonates, infants (1-12 months), toddlers (1-2 years), children (3-10 years or 11-18 years).

Injection Dose Delivery Device for Pediatric Patients

- Consider the appropriate dose delivery device for the prescribed dose.
  - AI/PFS (fixed dose) vs. PFP with dialable button (varying dose)
  - Single dose vs. multiple dose vs. single-patient use
- Consider the appropriate dose delivery device size for the prescribed dose.
  - Can the AI contain the needed injectable volume?
  - Can the PFP meet the full range of dosing?
  - Number of injections required to deliver the intended total dose.
  - Ensure consistencies between dose and markings for dialable button.

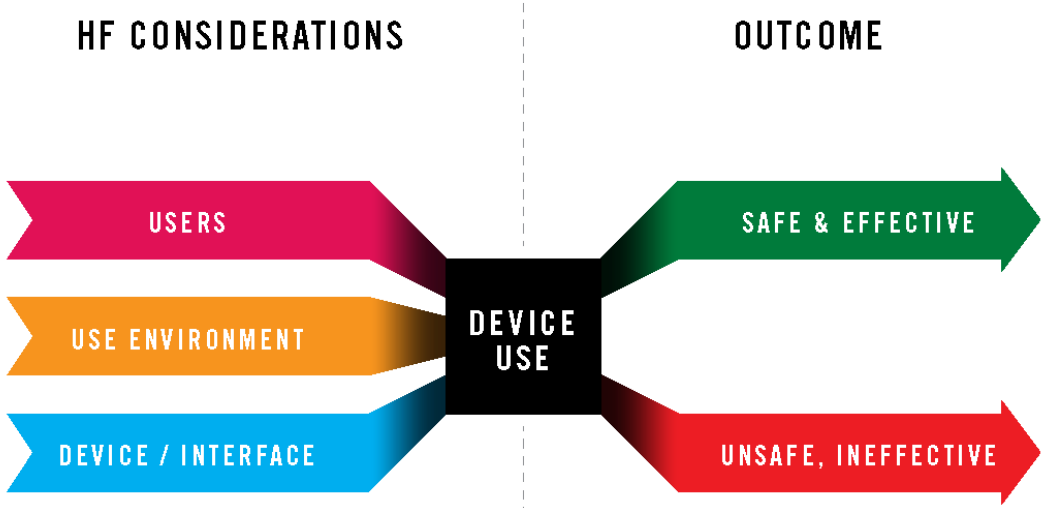
Adding Pediatric Indication(s) to Approved Product

- Consider physical and cognitive differences:
  - For example: a nasal spray designed for adults may have a tip that is not appropriately sized for a pediatric nostril, potentially resulting in failure to deliver any dose to pediatric patients.

Physical Characteristics	Cognitive Characteristics
• Physical size, strength, and stamina • Physical dexterity and flexibility • Sensory abilities (e.g., vision, hearing, tactile sensitivity)	• Cognitive abilities (e.g., memory and executive function) • Literacy and language skills • Knowledge and experience • Willingness and motivation

DMEPA's Approach…

- To ensure safe and effective use of products intended for the pediatric population, we *generally* recommend conduct HFVS with the intended pediatric users in the intended use environment with the intend-to-market products.
- Note that an HF validation study is *not* a clinical study.



Importance of Conducting HFVS with Pediatric Participants

Importance of Conducting HFVS with Pediatric Participants

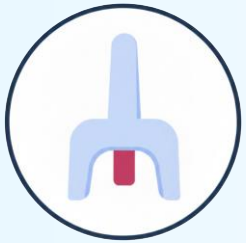
- HFVS that includes pediatric participants is needed because:
  - Pediatric users may self-administer or be the administrator to the patient.
  - Post-marketing experience (e.g., epinephrine autoinjectors, insulin pens, and naloxone etc.) demonstrated that children are already using these devices for self-administration or administration to the patient in community settings.
    - All 50 states and DC allow students to carry prescribed epinephrine at school.[3]
    - Communities have undertaken efforts to train children as young as 8 years to administer naloxone in opioid emergencies because approximately 11% of US children under 14 live with at least one family member who is or was addicted to opioids.[4,5]
    - Clinical guidelines from the International Society for Pediatric and Adolescent Diabetes (ISPAD) note that most children over 10 can self-inject or assist with administration.[6]
  - "The most important consideration for test participants in human factors validation testing is that they represent the population of intended users." – Guidance for Industry and Food and Drug Administration Staff *Applying Human Factors and Usability Engineering to Medical Devices* (February 2016)

Importance of Conducting HFVS with Pediatric Participants

- HFVS that includes pediatric participants can:
  - Demonstrate and validate the safe and effective use of the product by and/or for the pediatric population.
  - *Or* point to situations where data do not support or limit pediatric patients' independent self-administration.
  - For example, we have seen cases where previous HFVS data supported self-administration in patients aged 12 to 17 years, but a subsequent HFVS conducted to evaluate younger patients (aged 6 to 11 years) did not demonstrate successful independent self-administration in this age group.

Considerations for Conducting HFVS with Pediatric Participants

Considerations for HFVS with Pediatric Participants

Intended Uses:	 Emergency Uses	 Acute/Episodic Uses	 Chronic Uses
Intended User(s):	 Healthcare Providers	 Adult Caregivers	 Pediatric Patients
Intended Use Environment:	 Clinical Setting	 Home Setting	 Public Setting

Considerations for HFVS with Pediatric Participants

- Ensure the pediatric participants enrolled in the study are reflective of the indicated pediatric age range.
- Ensure parent or guardian intervention are documented when pediatric participants call upon them for assistance as they normally would in real life.
- Ensure the roles and involvement of each participant are clearly and distinctly reported (e.g., tasks the pediatric patient completed versus tasks pediatric patient completed with caregiver assistance)
- We generally expect the study language to be pediatric-friendly.

Key Takeaways

- It is important to consider human factors when developing and designing the user interface (not just dose delivery device) intended for pediatric population.
- HFVS can help to validate the user interface, including the dose delivery device.
- If products are intended to be used by pediatric patients, HFVS should include pediatric participants.

We look forward to your questions during the panel discussion.

References

1. H. Shonna Yin, Ruth M. Parker, Lee M. Sanders, Benard P. Dreyer, Alan L. Mendelsohn, Stacy Bailey, Deesha A. Patel, Jessica J. Jimenez, Kwang-Youn A. Kim, Kara Jacobson, Laurie Hedlund, Michelle C. J. Smith, Leslie Maness Harris, Terri McFadden, Michael S. Wolf; Liquid Medication Errors and Dosing Tools: A Randomized Controlled Experiment. *Pediatrics* October 2016; 138 (4): e20160357. 10.1542/peds.2016-0357
2. CDC's General Best Practice Guidelines for Immunization https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/downloads/general-recs.pdf; accessed on June 16, 2026.
3. https://advocacy.allergyasthmanetwork.org/state-laws/#self-carry-epinephrine; accessed on June 16, 2026.
4. https://beginningstreatment.com/should-children-be-taught-to-administer-naloxone/; accessed June 16, 2026.
5. https://whyy.org/segments/n-j-may-require-that-students-learn-to-administer-od-reversing-drug/; accessed June 16, 2026.
6. Danne T, Phillip M, Buckingham BA, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Insulin Treatment in Children and Adolescents with Diabetes.