Preventing Medication Errors: Designing User Interfaces to Prevent Medication Errors

Lolita White, PharmD
Human Factors Team Leader
Division of Medication Error Prevention and Analysis
Office of Medication Error Prevention and Risk Management
Office of Surveillance and Epidemiology
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Learning Objectives

- Describe the Division of Medication Error Prevention and Analysis' role in pre-marketing and post-marketing activities to prevent and address medication errors.
- Assess current strategies aimed to increase the safe use of drug products by minimizing use error that is related to the design, naming, labeling, and/or packaging of drug products.
- Evaluate examples of regulatory action taken to address recent medication errors.
- Discover how you can help identify, prevent, and mitigate medication errors.

Presentation Outline

1. Introduction to DMEPA
2. Safety Considerations for Product Design
3. Safety Considerations for Labels and Labeling
4. Your Responsibility in Medication Error Prevention

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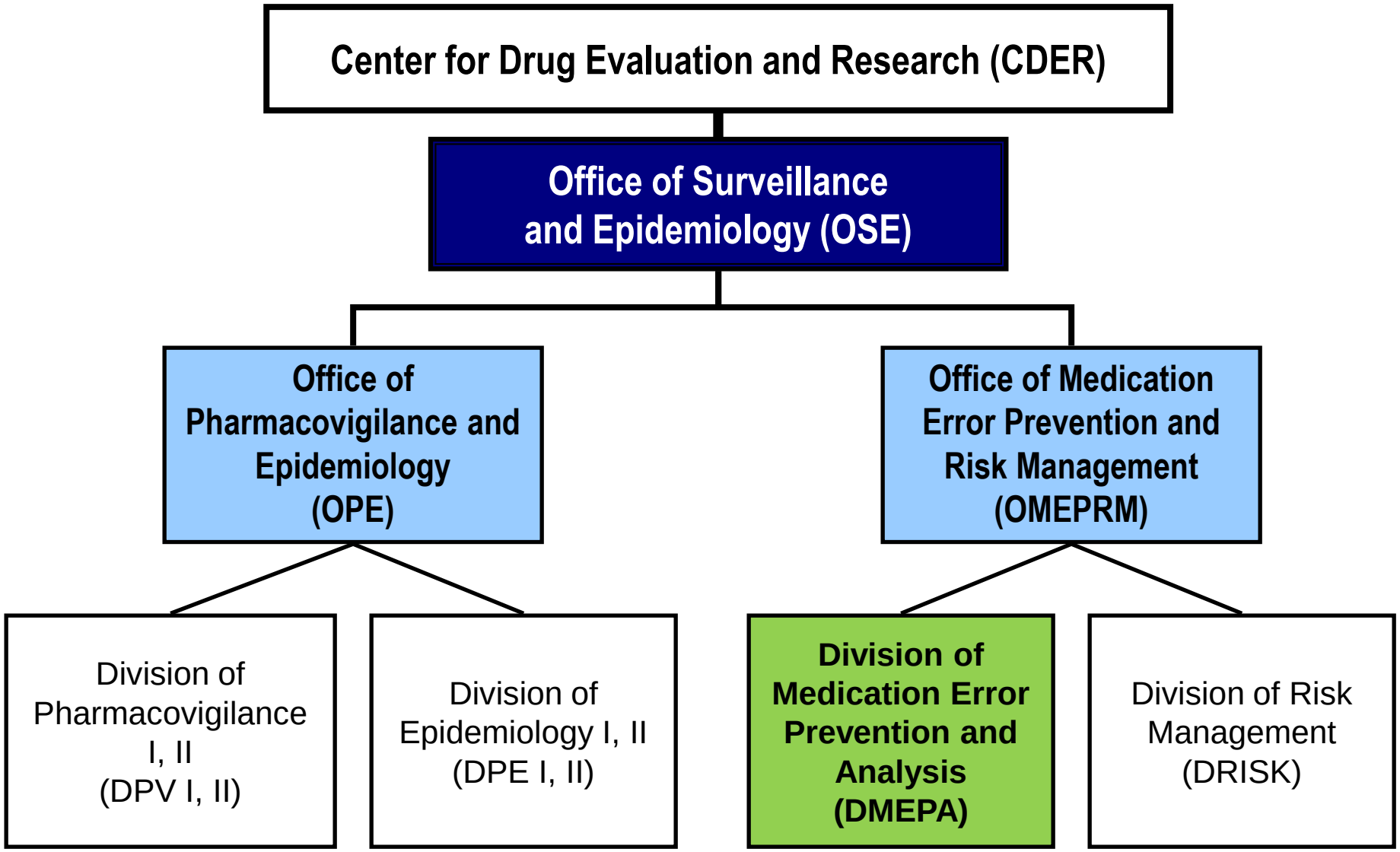

Center for Drug Evaluation and Research (CDER)
Office of Surveillance and Epidemiology (OSE)
Office of Pharmacovigilance and Epidemiology (OPE)
Office of Medication Error Prevention and Risk Management (OMEPRM)
Division of Pharmacovigilance I, II (DPV I, II)
Division of Epidemiology I, II (DPE I, II)
Division of Medication Error Prevention and Analysis (DMEPA)
Division of Risk Management (DRISK)

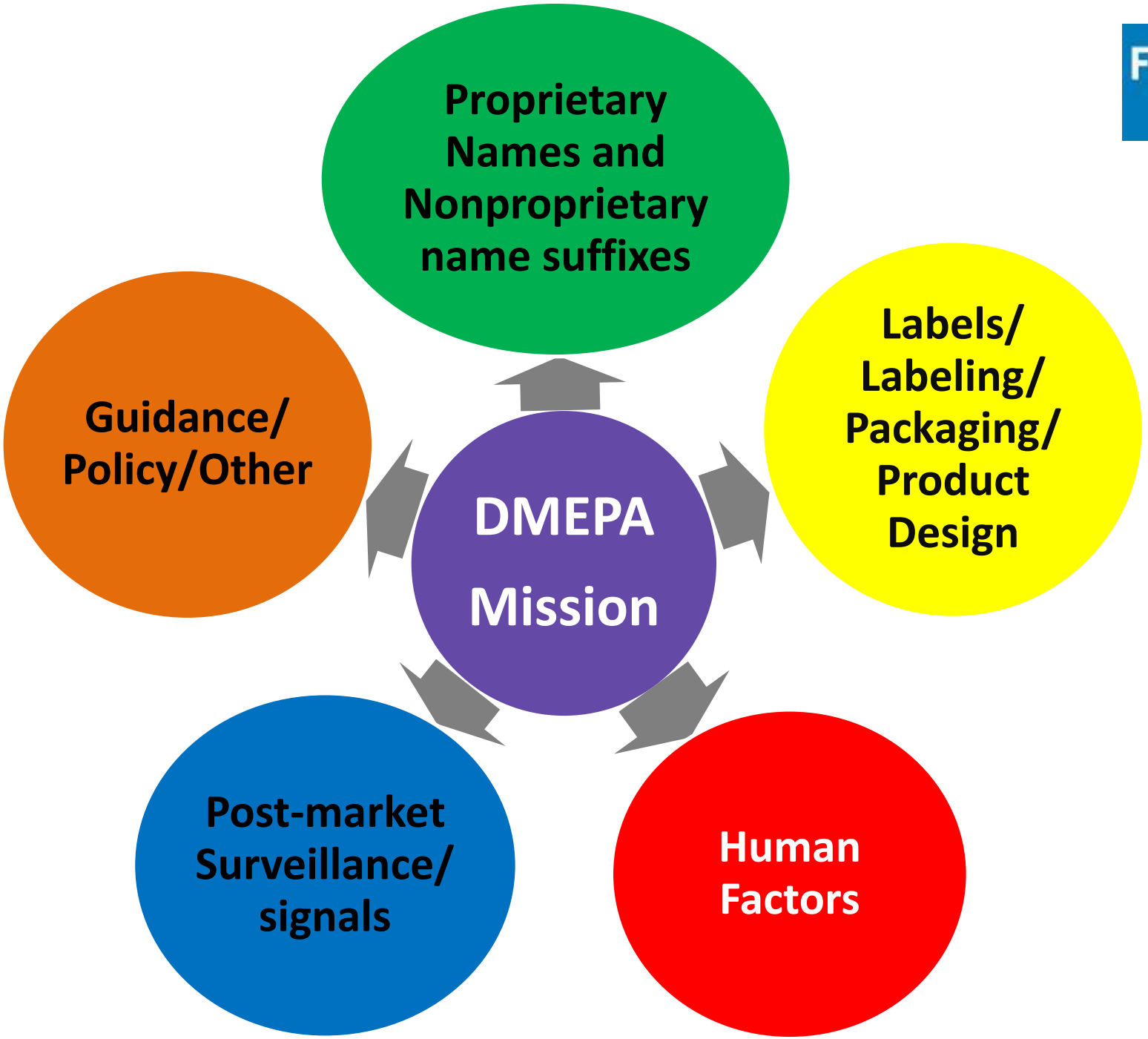
Who Looks at Medication Errors?

Division of Medication Error Prevention and Analysis (DMEPA)

- Created in 1999
- 60 employees
- Scientists and healthcare professionals with varied backgrounds
- Aligned by therapeutic areas
- Leads CDER review pertaining to medication error prevention and analysis for drug and therapeutic biologics

DMEPA Mission

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


Proprietary Names and Nonproprietary name suffixes
Labels/ Labeling/ Packaging/ Product Design
Human Factors
Post-market Surveillance/ signals
Guidance/ Policy/Other
DMEPA Mission

What is a Medication Error?

A medication error is any

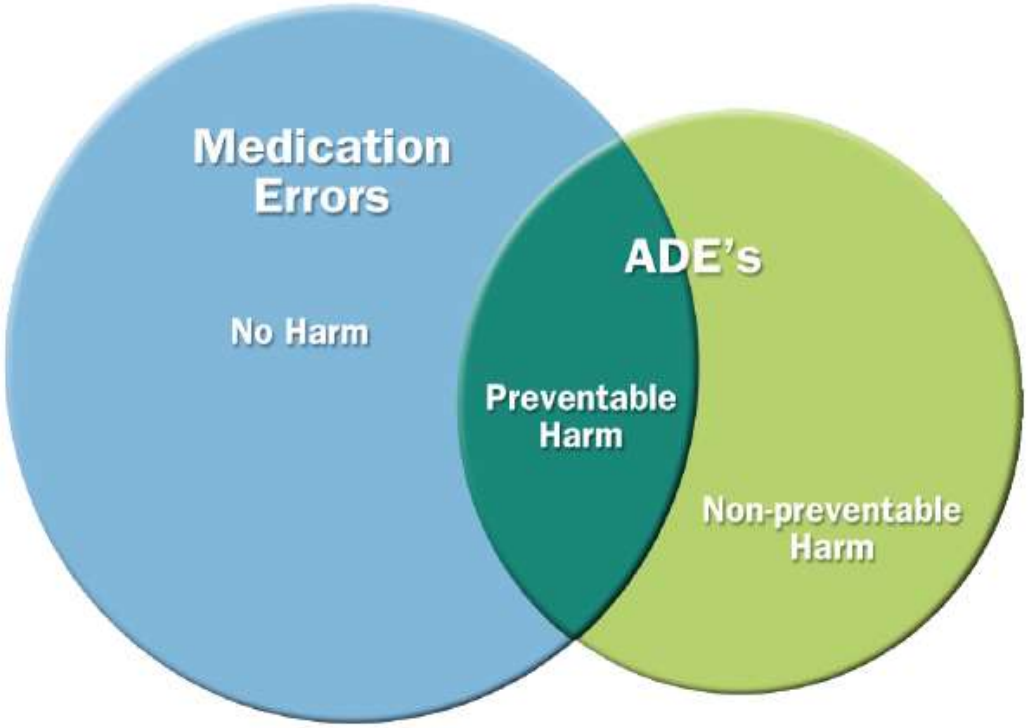
preventable

event that

may cause or lead to inappropriate medication use or patient harm

while the medication is in the control of the health care professional, patient, or consumer

Figure 1: Relationship between medication errors and ADEs



[1]Adapted from Figure 1 in Qual Saf Health Care 2004;13:306–314. doi: 10.1136/qshc.2004.010611

National Coordinating Council for Medication Error Reporting and Prevention. Available at: www.nccmerp.org. Accessed 12/30/2014

Culture of Safety

"**People make errors**, which lead to accidents. Accidents lead to deaths. The **standard solution is to blame the people involved**. If we find out who made the errors and **punish them, we solve the problem, right?**

Wrong. The problem is **seldom the fault of an individual; it is the fault of the system**. Change the people without changing the system and the problems will continue."

Don Norman

The Design of Everyday Things

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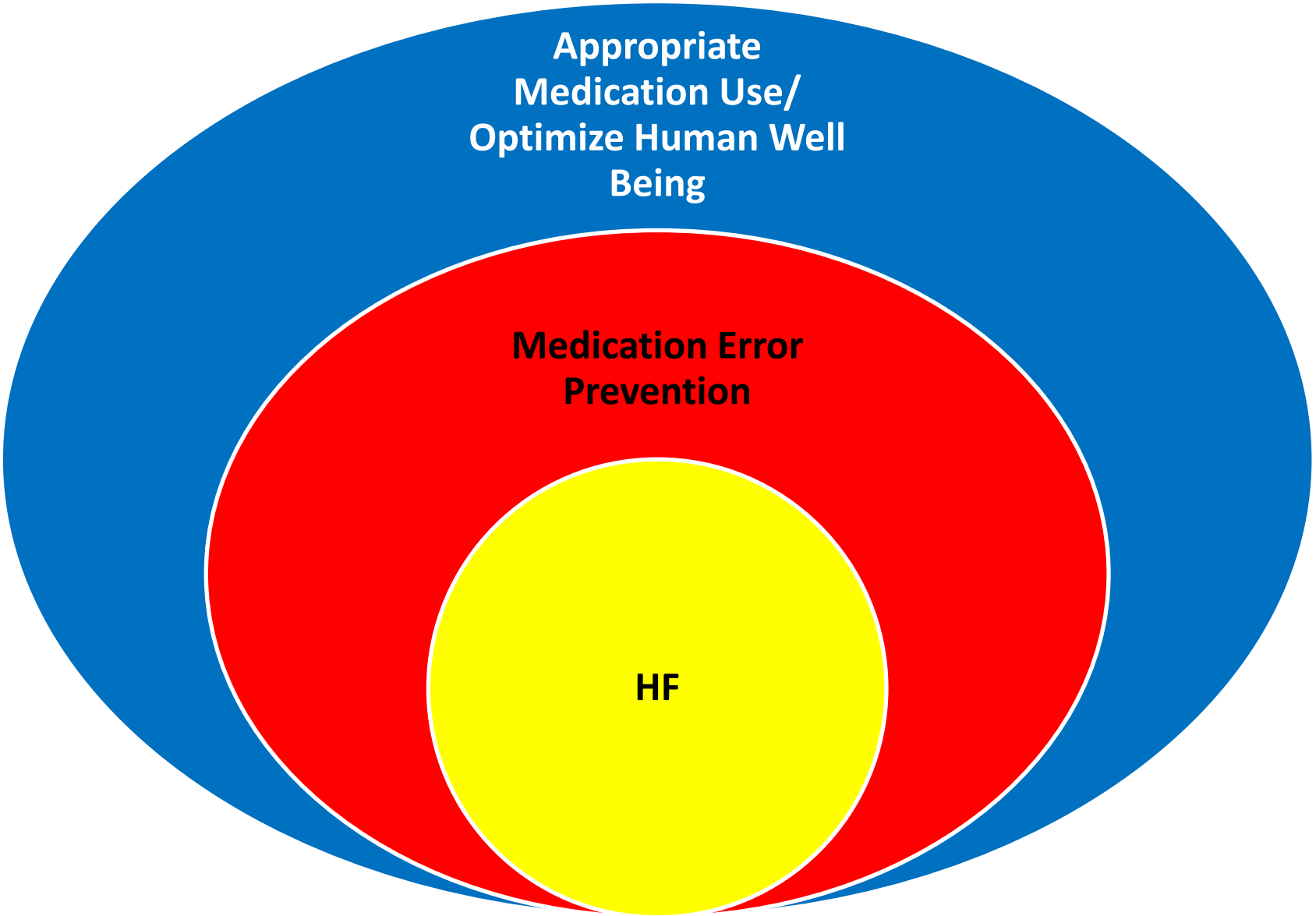
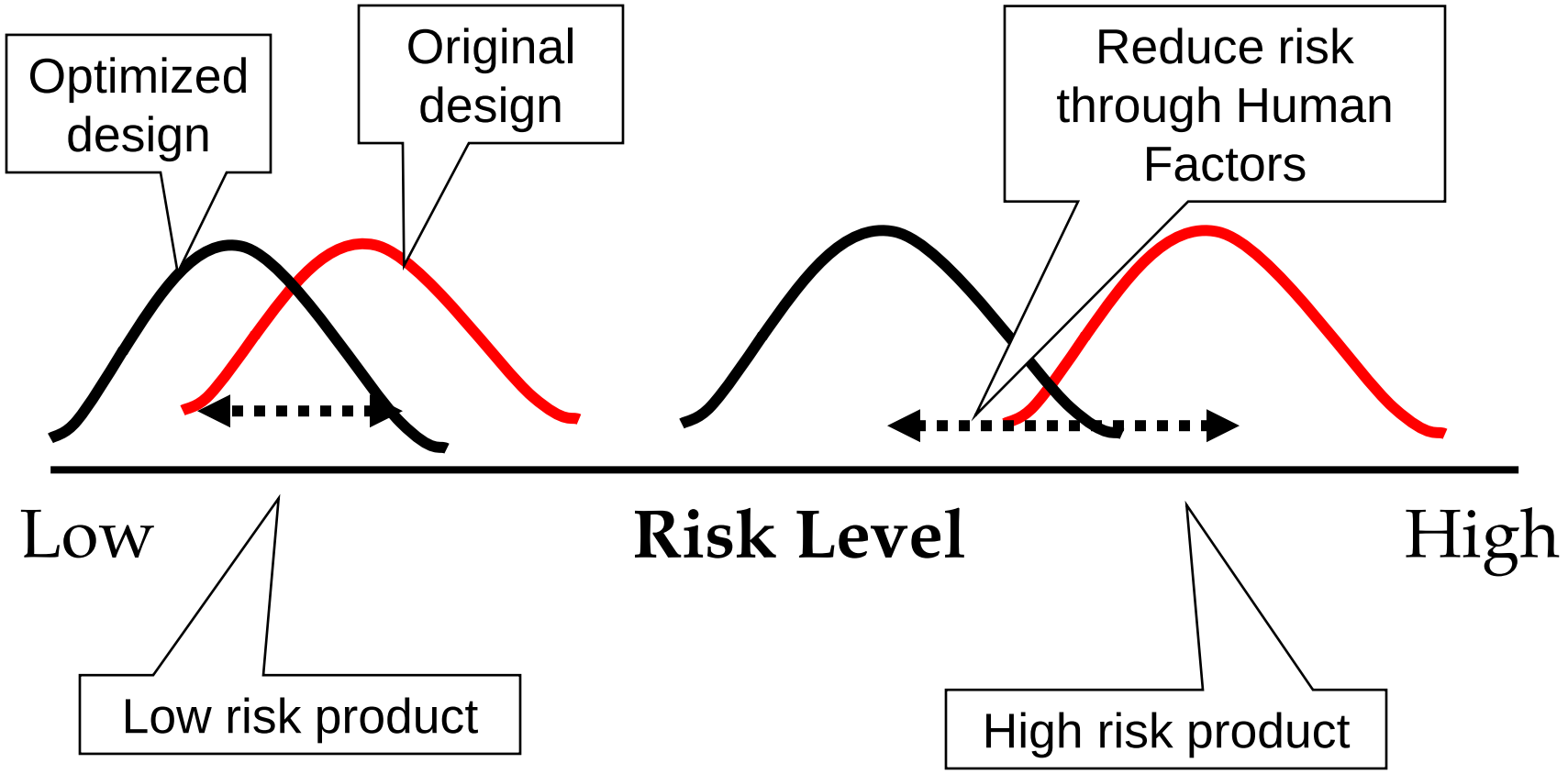
Medication Error Prevention and HF



Removal of Use Errors through HF



Regulatory Authority

Device:
21 CFR 820.30
Requirement of device

Drug:
- Kefauver-Harris Amendment to the 1938 Food, Drug and Cosmetic Act

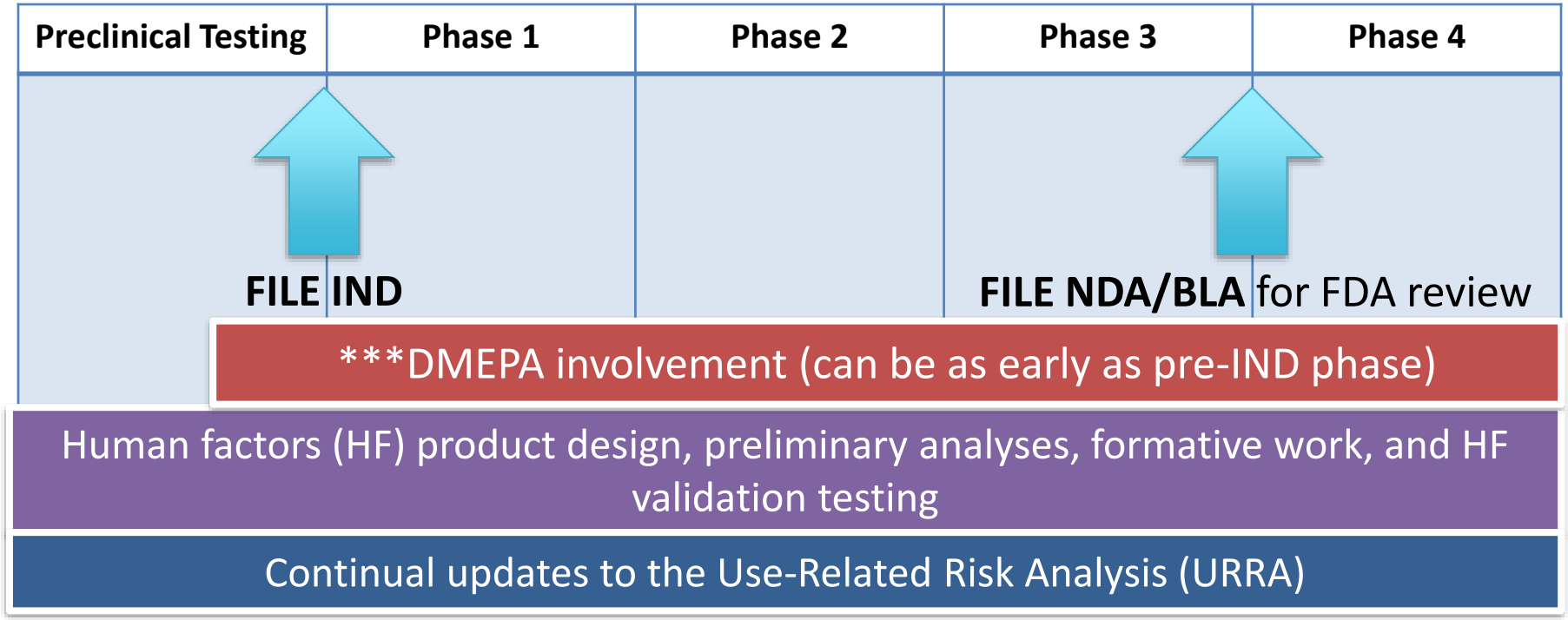
HF studies may be needed to demonstrate elimination/minimization of use-related hazards and medication errors

effective use

improved product design including packaging, nomenclature, and labeling

- PDUFA IV development goal: ensure drug safety by prospectively designing a drug that minimizes the risk for errors made by intended end users.

Drug Development Process & Human Factors Considerations for Commercial (to-be-marketed) Product



HF Evaluation of Drug, Biologic, and Combination Products in CDER

DMEPA is the lead for review of human factors submissions (e.g., protocols, study reports, etc.) within CDER

- Evaluate HF submissions for drugs, biologics, and combination products regulated by CDER
- OSE/DMEPA will identify the need for and issue inter-center consults to the CDRH Human Factors Team as needed
- OSE/DMEPA consults Patient Labeling Team in the Office of Medical Policy for the review of Instructions for Use (IFU) in the IND phase

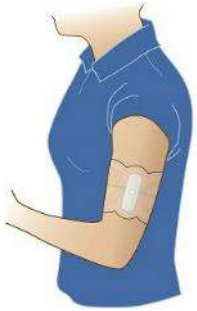
Combination Products

- Formal Definition in 21 CFR 3.2:
  - Therapeutic and diagnostic products
  - Combine >1: drugs, devices, biological products
- They can be:
  - Physically or chemically combined (21 CFR 3.2(e)(1))
  - Co-packaged in a kit (21 CFR 3.2(e)(2))
  - Separate, cross-labeled products (21 CFR 3.2(e)(3) or (4))

Combination Product Examples

- Prefilled Syringes
- Pen Injectors, Autoinjectors

- Pharmaceutical Aerosol Delivery Devices/Inhalation Products
- Transdermal Delivery Systems/Patches
- Drug Infusion Devices
- Kits containing drug and administration devices



Evaluation of Use-Related Risk URRA

- The URRA is the Foundation for product design and HF study designs
- Consider intended users, uses, and use environments
- Identify all **critical tasks** required for using the combination product
- Explain consequences of failing a critical task and mitigations to decrease risk of task failures

Proactive Risk Assessments

- In the development of drug products, it is important to
  - Understand how users interact with the product user interface
  - Identify specific tasks or use scenarios that can cause harm
  - Correct identified risks

- These methods should be applied early in drug development to build safety into the product design and throughout a drug product's life cycle

Early Stage Considerations: End Users and Environment of Use

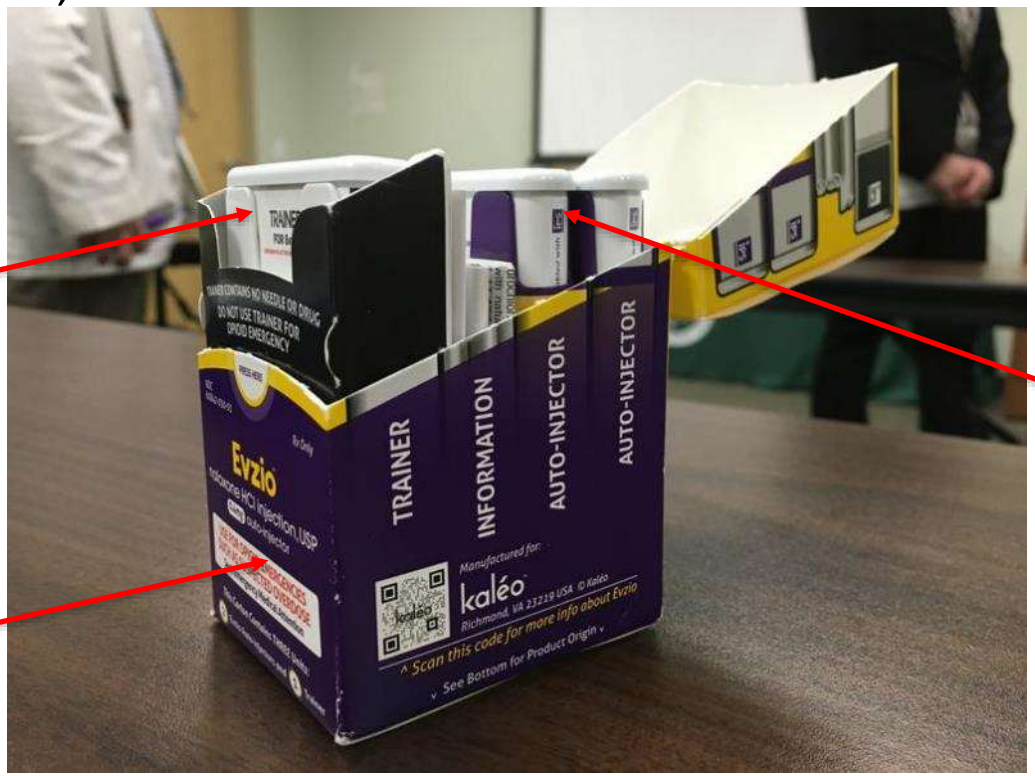
- Considering end users during drug development can allow identification of risks that can lead to error
- Consider all users and all environments of use **throughout the entire medication use process**

Your User Interface (UI)* is Not Just the Device

User interface: includes all points of interaction between the product and the user(s) including elements such as displays, controls, packaging, product labels, instructions for use, etc.

Labeling

Packaging



Delivery Device Constituent Part

*Draft Guidance for Industry: Comparative Analyses and Related Comparative Use Human Factors Studies for a Drug-Device Combination Product Submitted in an ANDA

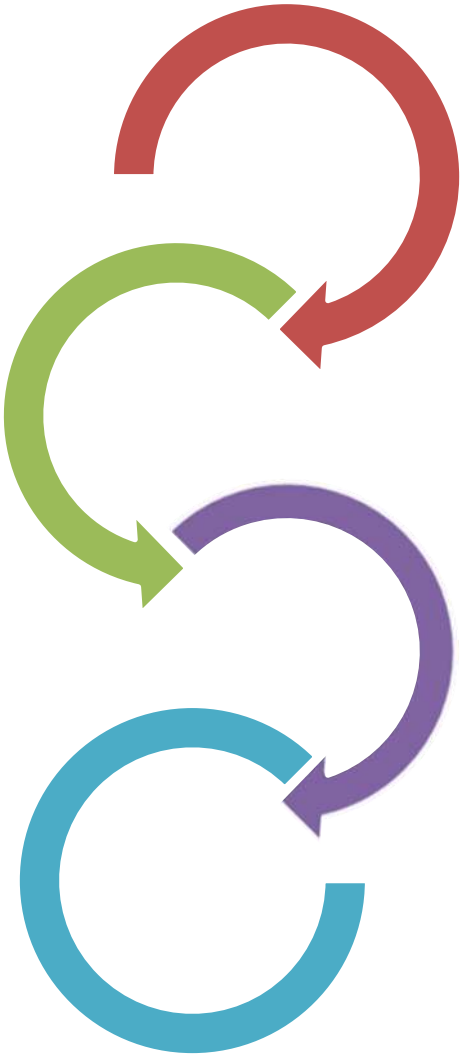
Drug Product User Interface

- Most effective strategies focus on improvements to design of drug product user interface
  - Drug product user interface: all points of interaction between the product and the user (i.e., packaging, displays, controls, product labels, instructions for use, etc.)
- Evaluate how and why problems have occurred with similar products
  - Identify error prone features and eliminate them from design
  - Prevent same errors from occurring
- Consider lessons learned to minimize risks associated with the designs

Why Simulated Use Testing

- We recommend human factors studies be conducted to characterize risks as well as develop mitigation strategies.
  - Help determine whether users can safely and correctly perform critical tasks
  - Seeks to assess actual use in a systematic fashion
  - Results can be used to update the URRA

Interlocking HF Process



Performance Data and Subjective Feedback

Root cause analysis

What aspects of the user interface need to be further optimized based on the root cause analysis?

Does the change introduce new risks and/or need to be validated?

Human Factors Validation Study

- Demonstrates product can be used by the **intended users**, under **expected use conditions**, **without use errors or patient harm**

- Testing design:
  - The test participants represent the intended (actual) users of the product.
  - All critical tasks are performed during the test
  - The-user interface represents the final design
  - The test conditions are sufficiently realistic to represent actual conditions of use

HF Review Report Questions

- Does the subject product user interface (UI) support safe and effective use?
- Or otherwise stated, is the UI free from design flaws or inadequacies that could cause harm from inadvertent use error?
  - *What data facilitates the answering of this question and what data does not?*

Human Factors Validation Study

- Analysis of Test Results
  - Aggregate objective and subjective data to:
    - Identify potential use errors and determine the root causes
  - Address use errors and problems (difficulty, confusion, close calls) through risk management strategies
  - Conduct additional human factors validation testing on the modified user interface elements

Human Factors Validation Study

- Residual Risk
  - True residual risk is beyond practicable means of risk reduction through elimination, mitigation or control

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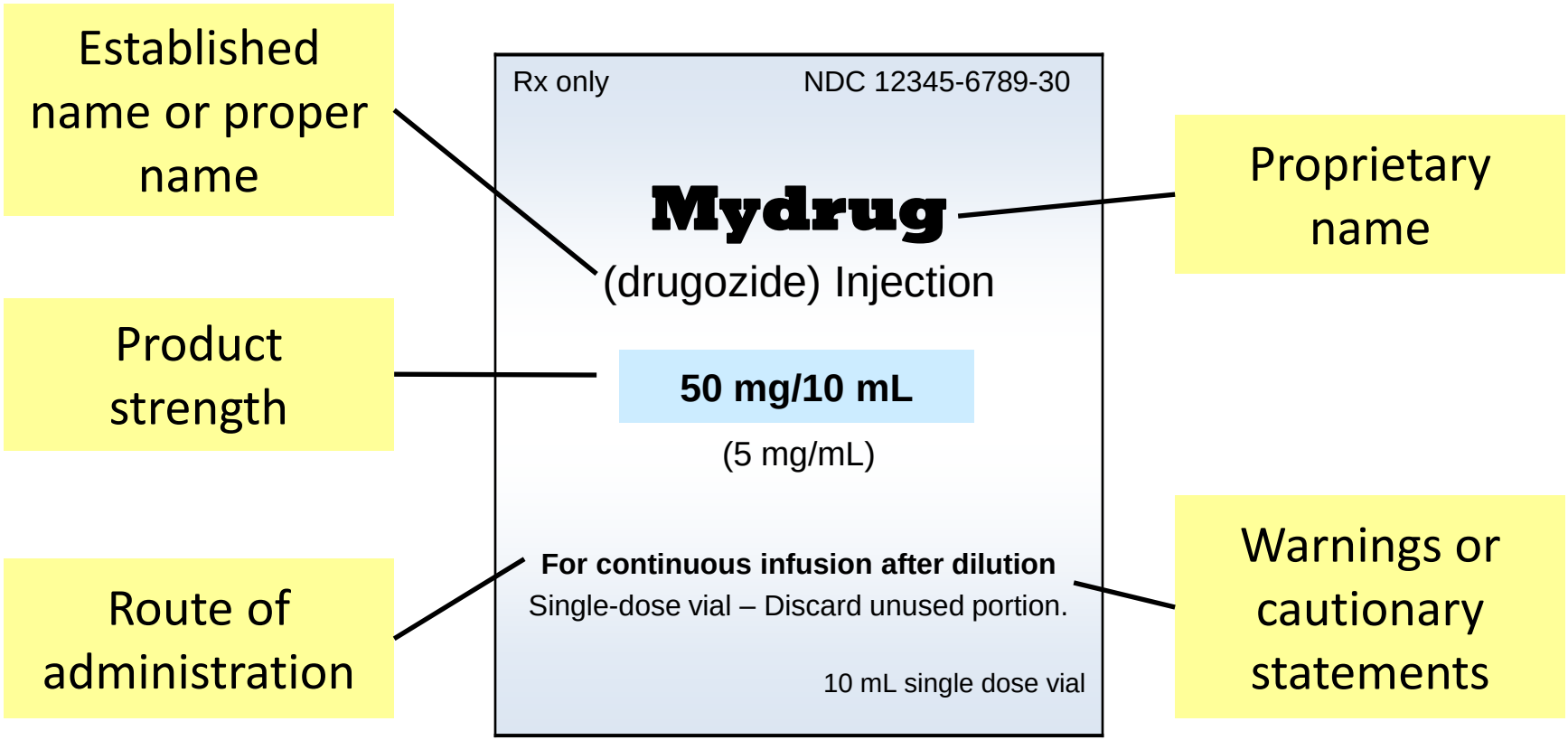
Look-alike Labels and Labeling

Principal Display Panel (PDP)



Information Crowding/Visual Clutter on Labels:

- When labels are crowded, important information may be difficult to read or easily overlooked
- Therefore, we ensure that
  - lines or blocks of text are separated by sufficient white space
  - Text is not superimposed by images or logos
  - Less important information is located on back panels, side panels, or in prescribing information

Route of Administration

- Avoid use of abbreviations
- Use positive statements instead of negative statements
  - E.g., May overlook the word “not” in **NOT FOR INTRATHECAL USE**
  - Affirmative statements help to ensure readers understand the intended route of administration, even if they do not read every word

Dangerous Abbreviations, Acronyms, and Symbols

- Certain abbreviations, acronyms, and symbols are dangerous and should not be used*

- Non-standardized abbreviations, symbols, and dose designations can also lead to mistakes

Abbreviations	Intended Meaning	Misinterpretation	Correction
µg	Microgram	Mistaken as "mg"	Use "mcg"

*ISMP's List of Error-Prone Abbreviations, Symbols, and Dose Designations [Internet]. Horsham (PA): Institute for Safe Medication Practices. 2015. Available from: http://www.ismp.org/tools/errorproneabbreviations.pdf.

Product Strength – Unit of Measure

- Product strength designations should use a consistent unit of measure across all elements of labels and labeling

Dosing for Perioperative Hypotension

Intravenous bolus administration:
50 mcg to 250 mcg

- **Metric Measurements**
  - Dose or strength expression should appear in metric units of measure (mL, mg, and mcg)

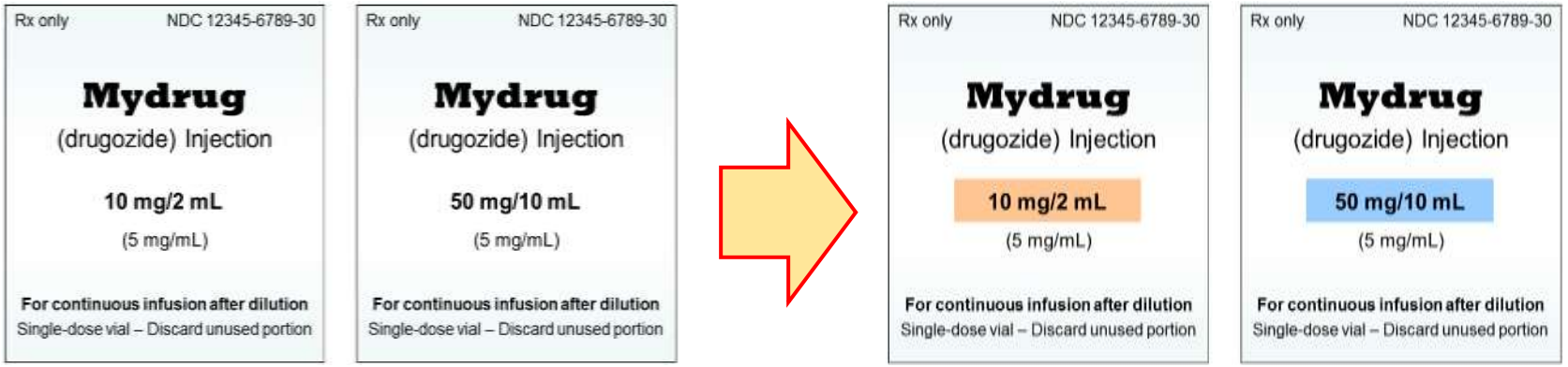
Strength expression on container label:

16.2 mg (1/4 gr)

Product Strength – Differentiation

- **Strength Differentiation:**
  - We ensure that the product strength stands out on the container label and carton labeling

- **Techniques include:**
  - Boxing
  - Prominent typeface or type weight
  - Color differentiation



Warnings for Critical Information

- Use affirmative statements
  - For intravenous infusion
  - Fatal if given by any other route
  - Must dilute before use

- Consider whether the statement is helpful to ensure safe use

Doctor's Prescription:
Take 6 mg orally once daily.

Patient: Took 1 mg orally once daily.

Patient stated she was following directions on the bottle

Institute for Safe Medication Practices. Safety Briefs: Positive change, negative consequence. ISMP Med Saf Alert Acute Care. July 2014;19(15):1.

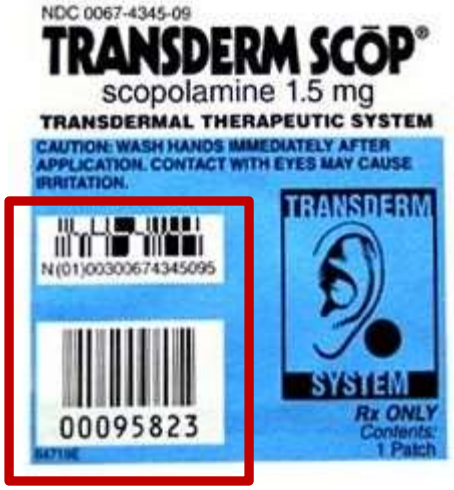
Storage

- If the product has special storage requirements, we ensure that the storage information is prominent
  - Must be refrigerated
  - Protect from freezing

- If applicable, we provide instructions for pharmacists to dispense the drug product in special container
  - Store in the original package to protect from moisture.
  - Dispense in original, unopened container

Barcode

- Ensure there is enough blank space surrounding barcode to allow barcode scanning per 21 CFR 201.25(c)(1)(i)



- Ensure that the barcode is not placed in an area where it can be easily damaged because it appears at the point of label separation (e.g. perforation)

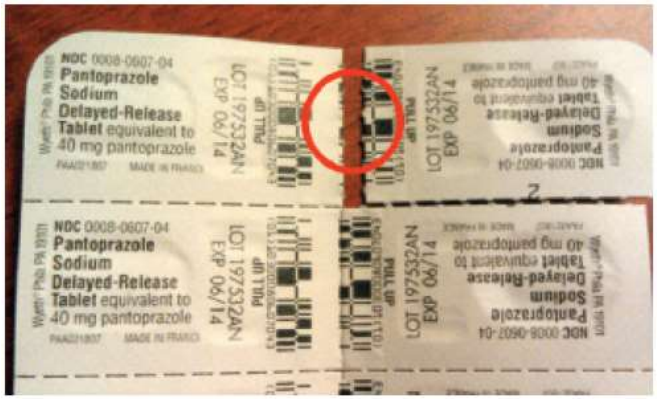


Figure 1. Barcode tears apart at perforation.

Institute for Safe Medication Practices. Safety Briefs: QC for barcodes. ISMP Med Saf Alert Acute Care. March 2013;18(5):1-2.

Example: Un-scannable Barcode

- Barcode scanning can help to ensure the right product is dispensed – not useful if they can't be scanned

Figure 1. Regranex barcode can't be scanned.

Before

- Regranex example:
  - Barcode runs across both sides of the tube near where it is crimped
  - Virtually impossible to scan properly

After

Institute for Safe Medication Practices. Safety Briefs: How NOT to barcode topical gels/creams. ISMP Med Saf Alert Acute Care. Feb 2016;21(3):4.

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FDA's Responsibility

- Minimizing error potential PRIOR to approval
- Correcting problems quickly AFTER detection through post-marketing surveillance
- Risk Communication and Management
- Research

Pharmaceutical Industry Responsibility

- Clear & Concise Labeling
- Avoid Misleading or Confusing Proprietary Names
- Propose Packaging with Minimal Error Potential
- Swift action when problems occurs

Practitioner Responsibility for Medication Error Prevention

- Review product labeling information prior to using an unfamiliar medication
- Communicate clearly with others involved in patient care
- Involve patients in their care
- Report side effects and medication errors to the FDA MedWatch program

Patients' Responsibilities

- Inquire and know the risks of treatment
- Expect and ask for medication counseling
- Report medication errors to FDA MedWatch program

Summary

- We aim to identify and address the risk prior to marketing to help prevent medication errors.
- The use of HF assessments, proactive risk assessments and results from HF validation studies help us to identify potential medication errors.
- If we are made aware of potential problems, we can work to provide effective interventions that may help minimize further errors.
- Post marketing experience also helps us anticipate potential errors.

Resource	Website
Guidances for Industry	
• Safety Considerations for Product Design to Minimize Medication Errors – April 2016	http://www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/UCM331810.pdf
• Safety Considerations for Container Labels and Carton Labeling Design to Minimize Medication Errors (*Draft*) – April 2013	http://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm349009.pdf
• Best Practices in Developing Proprietary Names for Drugs (*Draft*) – May 2014	http://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm398997.pdf
• Contents of a Complete Submission for Threshold Analyses and Human Factors Submissions to Drug and Biologic Applications September 2018	https://www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/UCM621902.pdf
• Applying Human Factors and Usability Engineering to Medical Devices – February 2016	http://www.fda.gov/downloads/MedicalDevices/.../UCM259760.pdf
Regulations	
• 21 CFR 200s, 300s and 600s	http://www.ecfr.gov/cgi-bin/textidx?tpl=/ecfrbrowse/Title21/21tab_02.tpl

FDA U.S. FOOD & DRUG ADMINISTRATION

Questions?

Questions

The Division of Medication Error Prevention and Analysis' role:

- A. work in pre-marketing activities to prevent and address medication errors.
- B. work in post-marketing activities to prevent and address medication errors.
- C. DMEPA is the lead division for review of human factors submissions (e.g., protocols, study reports, etc.) within CDER
- D. All of the above

Questions

One example of a regulatory action taken to address recent medication errors:

- A. Requiring all container labels to be the exact same uniform color
- B. Requiring the pharmacist to use an app to read all LASA drug names aloud prior to dispensing
- C. We don't address medication errors at the FDA
- D. Requiring the principle display panel to only include limited important product information to eliminate clutter and increase readability

Questions

How can you help identify, prevent, and mitigate medication errors?

- A. Healthcare providers should report all medication errors to MedWatch
- B. Patients can inquire and know the risks of their treatment
- C. Healthcare providers should Involve patients in their own care
- D. All of the above