Satisfying US and EU Human Factors Requirements for Inhaler Devices

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The Human Factors Engineering (HFE) process described in the presentation is based on our extensive experience in this area and our informed interpretation of the HFE guidance and standards.
About Cambridge Consultants

- We are an end-to-end product development company with a strong emphasis on human factors engineering (HFE).
- For over 55 years we have led the way in the Cambridge hi-tech cluster for innovative design & development.
- Our team of ~700 human factors engineers, designers, engineers and scientists have an enviable track record of world firsts and breakthrough developments.
- Human factors engineering (HFE) is an integral part of our Medical Development Process (MDP).
- Our MDP is compliant to ISO 13485 and US CFR Title 21.
We have Global Presence
We have many years of experience working for pharma and medtech clients

Some examples
We have a long track record of successful inhaler device development

Some examples of respiratory devices

Conix
High performance dry powder inhaler
Technology licensed to 3M in 2008

Tobi® podhaler
Inhaler for CF
Launched 2012
Design award winner

Starhaler
60-dose dry powder inhaler
Launched in India

T-Haler
Metered Dose Inhaler compliance & training device

NEXThaler
Breath actuated inhaler with mechanical dose counter
Launched 2013
Satisfying US and EU Human Factors Requirements for Inhaler Devices

- Background
- HFE regulations and their focus
- HFE Process
  - Fundamentals of HFE process
  - FDA process
  - EU (International) process
  - Single process for both US and EU
- Conclusion
Definition of HFE

“Human Factors Engineering (HFE) is the application of knowledge about human behaviour, abilities, limitations, and other characteristics of users to the design of medical devices and combination products”
Benefit of HFE

“The application of HFE helps manufacturers to develop products that

- reduce use errors,
- enhance patient and user safety,
- improve product usability and efficiency, and
- enhance user satisfaction”
HFE uptake

“The uptake of HFE in product development has been slow because:

- traditional product developers have often considered HFE only as a desirable aspect of the development process, or
- did not know how to incorporate it into the process so as to realize its benefit.”
Paradigm change

“The paradigm has started to change

- with the introduction of HFE/UE standards and guidance, and
- their enforcement by regulatory bodies such as the FDA”
Introduction

“HFE has become an important discipline for manufacturers around the world”
Understanding HFE

“There are Standards and Guidance specifying the HFE process but they are not user friendly!”

“This presentation attempts to provide an overview of the HFE process in a simple schematic way, clarifying the US and EU requirements and their differences.”
HFE Regulations and their Focus
HFE Standards and Guidance

FDA Guidance (medical devices)

FDA Guidance (combination products)

IEC 62366-1:2015 (medical devices and combination products)

IEC 62366-1:2015: Application of usability engineering to medical devices.
ISO 14971

ISO 14971:2007/2012: Medical devices – application of risk management to medical devices
Medical Device, Combination Products and HFE Pathway

**What Type of Product?**
- Device Only
- Device and Medicine
- Medicine Only

**What Type of Device?**
- In-Vitro Diagnostic
- Active Implant
- (Other) Medical Device
- Medical Device (Ancillary Medicinal Substance)

**What is the Principle Mode of Action?**
- Medicinal Element
- Device Element

**What Type of Medicine?**
- Medicinal Product (Combination Product)
  - Drug
  - Biologics

**MEDICAL DEVICE**
- Compliance Assessed by NB

**MEDICINAL PRODUCT**
- Compliance with Relevant Parts of CFR Title 21 Part 800-898
- Compliance Assessed by CDRH for device

**HFE Requirements in IEC 62366-1**

**EU**
- Compliance with Medicinal Products Directive 2001/83/EC
- Compliance Assessed by EMA

**US**
- Compliance with Relevant Parts of the CFR Title 21 Part 200-499, 600-680
- Compliance Assessed by CDER/CBER
Focus of HFE Process

- **Effectiveness**
  - Accuracy and completeness
  - Freedom from unacceptable risk

- **Safety**
  - Freedom from discomfort and positive attitude towards product
  - Resources expended in relation to effectiveness
  - For example, improved sales

- **Superior Usability** (usability beyond safety and effectiveness)
  - Generally NOT the focus of HFE/UE Regulatory Process
  - If any of these affects safety or effectiveness, then it is the focus of HFE/UE process

- **User Satisfaction**
- **Efficiency**
- **Other Commercial Benefits**

Focus of HFE/UE Regulatory Process

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Benefits of HFE Process

- Improved sales
- Competitive advantage
- Reduced time to market
- Simpler training
- Reduced demand for customer support
- Better treatment compliance rates
- Superior Usability (usability beyond safety and effectiveness)
  - Other Commercial Benefits
  - User Satisfaction
  - Efficiency
- Increased utilization of available features
- Better application of currently available technology
- Fewer returned products
- Reduced chances of product recall
- Reduced chances of litigation
- Safe product
- Effective product
- Usability related to safety and effectiveness
Human Factors Engineering Process
Fundamentals of HFE process

1. Understand Users and Use Characteristics
   - Patients, Users, Use-Environment, Operating Principles, etc.
   - Contextual enquiry
   - Observation
   - Interviews
   - Desk-based research

2. Analyse Safety and Effectiveness Issues
   - What could go wrong in terms of safety and effectiveness
   - Task/functional analysis
   - Investigating known use-related problems
   - Use-related risk assessment

3. Design, Evaluate and Optimize
   - Design of user-interface
   - Heuristic analysis
   - Expert review
   - Cognitive walk-through
   - Simulated use assessment

4. Validate
   - Demonstrate that the product is safe and effective
   - Simulated use testing
   - Actual use testing

5. Evaluate Residual Risk
   - Analyse whether residual risks are acceptable and/or outweighed by the benefits
   - Risk management
   - Risk-benefit analysis

6. HFE/UE Report
   - Summarize all HF activities concluding safety and effectiveness
   - HFE/UE Report
FDA Human Factors Process

- Understanding Users, Uses and Use-Environments
  - Identification and Categorization of Critical Tasks Based on Severity of Harm
  - Use-Related Risk Assessment (e.g. use FMEA)
  - Preliminary Analyses and Evaluations
    - Analytical Analyses and Evaluations
      - Task Analysis
      - Heuristic Analysis
      - Expert Review
    - Empirical Analyses and Evaluations
      - Contextual Inquiry Interviews
      - Formative Evaluations (cognitive walk-through, simulated use testing)
  - Investigation into Known Use-Problems
- Design of User Interface
  - Design and Optimization of User Interface
    - Device (controls, display, etc.), Packaging, Labels, IFU, Training Materials, etc.
  - Develop and Implement Risk Mitigation/Control Measures
    - Inherent Safety by Design
    - Protective Measures
    - Information for Safety
- Risk Management Process
  - Risk Management
  - Evaluate Residual Risk
- Validation Testing
  - Critical Tasks to be Included in Validation Testing
- Optimised User Interface
  - Representative of Final Design
- HFE/UE Report
  - Summarising HFE Activities Leading to Safe and Effective Product
If a New Problem is Identified
If Further Improvement is Practicable and Necessary

EU Human Factors Process

Risk Management Process

Risk Management

Use-Related Risk Assessment (e.g. use FMEA)
Hazard and Hazardous Situations
Hazard and Sequence of Events Leading to Hazardous Situations

Use Specification

User Interface Characteristics Related to Safety
- Task analysis
- Functional analysis
- Investigation into known use problems

Formative Evaluation
- Cognitive Walk-Through
- Expert Review
- Usability Test

Hazard-Related Use Scenarios Based on Severity of Harm

Hazard-Related Use Scenarios for Summative Evaluation

Summative Evaluation

Design of User Interface

Design and Optimization of User Interface
Develop and Implement Risk Mitigation/Control Measures

User Interface Specification
User Interface Evaluation Plan
Design of User Interference
Optimised User Interface Representative of Final Design

Usability Engineering File
Results and Record of Usability Engineering Process / Activities

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Common Approach to Satisfy both US and EU Submissions

Use Specification / Statement of Intended Use
Understanding Indication, Patients, User, Use-Environment, Operating Principles, etc.

User Interface Characteristics Related to Safety/Analytical Analyses and Evaluations
Identification of Known Use-Related Problems
Task Analysis

Formative Evaluation(s)
It is an iterative process and may require more than one formative evaluations
Good HF/UE practice suggests conducting at least one formative evaluation ahead of a summative evaluation (validation testing)

Summative Evaluation / Validation Testing
With representative users, use-environment and final design

HFE/UE Report (Usability Engineering File)
Summarising all HF activities
Concluding the product is safe and effective

RISK MANAGEMENT PROCESS
Other Risk Assessments, e.g. Design and Process Risk Assessments
Use-Related Risk Assessment
Initial User-Related Risk Assessment Update

DESIGN AND DEVELOPMENT PROCESS
User Interface Development Improvement Finalisation
Other Aspects of Design and Development, e.g. Engineering

Initial User-Related Risk Assessment
Use-related Risk Assessment Update
User Interface Qualification

RISK MANAGEMENT PROCESS
Other Risk Assessments, e.g. Design and Process Risk Assessments
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DESIGN AND DEVELOPMENT PROCESS
User Interface Development Improvement Finalisation
Other Aspects of Design and Development, e.g. Engineering
Tailored HFE Processes

- There are situations where full-scale human factors or usability engineering process may not be required
  - Legacy products (products with user-interface of unknown provenance, UOUP)
  - Generic / biosimilar products
  - Products for use in a clinical trial
  - Products with low risks
  - Products with partial or no HFE documentation (Remediation Work)
Conclusions
Conclusions

- HFE is an **essential and integral part** of the inhaler device development process.
- The process requirements are primarily based on the core principles of **safety and effectiveness**.
- The HFE processes for the FDA and EU submissions are **largely harmonized**, but there are **some minor differences**.
- It is important that manufacturers of inhaler devices **understand the process clearly** so that they can comply with the requirements.
- Following the HFE process does not only **fulfil the regulatory requirements** but also helps you to **develop better products**.
- This presentation provides the **holistic view** of the HFE process in a simple schematic way, however every project is different and the process should be **tailored accordingly**.