Human Factors Engineering in the Healthcare Industry

Ed Israelski
Cindy Miller
Eric Bergman
Merrick Kossack
Bonnie Hautamaki
Moderator
Rob Albert – GE Healthcare

Rob has applied HF principles to medical device and UI design for over 12 years. Rob currently works for GE Healthcare where he is facilitating the adoption of an iterative, user centered, design process across healthcare products. In his role as HF engineer and design architect, he leads a cross functional UX team that develops user interfaces with an emphasis on improving patient safety, usability and user experience.

Contact Rob: Email, rob.albert@ge.com
Facilitator
Edwin Madigan - McKesson

Ed has worked in the field of Human Factors for over 19 years. Edwin has applied HF principles and techniques to create usable products in the domains of transportation, retail, banking, telecommunication, and health care. Edwin works for McKesson Provider Technologies and leads the design efforts for the Horizon Ambulatory Care EMR application.
Key Takeaways:

1.) An improved understanding of industry practices in Human Factors engineering.

2.) A description of the activities a practicing HF Engineer performs in the industrial setting.

3.) Lively and informative discussion about the role, impact and future direction of HFE and Healthcare products and devices.

4.) Improved communication channels among Healthcare Providers, Regulatory Agencies, Academic Researchers and Industry Practitioners.
Ed has been director of human factors at Abbott Labs where he leads a cross-division team to imbed best-practice HFE design methods into all of their products for the last 10 of over 35 years in the HFE field. He is co-chair of the HFE Committee for the AAMI Standards organization and convener of the medical device Usability Engineering groups for the international standards organizations ISO and IEC.
Human Factors at Abbott: The Broker Model

Edmond W. Israelski PhD, CHFP

Director of Human Factors

Abbott  Quality and Regulatory
Outline

- Why Human Factors at Abbott?
- Process Overview
- The Broker Model for Human Factors at Abbott
- HF Initiatives across Abbott
Abbott Overview

• Diversified Healthcare company
• Over 90,000 employees in 130 countries
• Over $40 Billion annual revenue
• Pharmaceuticals – Kaletra™, Humira™, Biaxin™, Omnicef™, Zemplar™, Tricor™, Niaspan™, Depakote, Oxycodone, Azmacort, Simcor, Synthroid
• Nutritionals – Ensure™, Similac™, Pedialyte™, Glucerna™, ZonePerfect™, EAS Edge™, NutriPals
• Devices
  • IVD Systems – Architect™, AxSYM™, Prism™, Aeroset™, Cell Dyne™, m2000™, PLEX-ID
  • Glucose Measurement – FreeStyle™, Precision™, Flash™, Navigator™
  • Medical Optics – LASIK, Intra-Ocular Lens, Solutions
  • Vascular – Xience™ Stents, StarCloser SE™ Closers, Catheters,
  • Point of Care – iSTAT 1™ hand held analyzer
• Patrol, Embrace enteral feeding pumps and sets
• Animal Health Devices
Why Human Factors at Abbott?

• Compliance
  • FDA and International Regulators are requiring human factors be used in design controls
  • ANSI/AAMI, IEC/ISO Human Factors standards issued

• Good Business Sense
  • High ROI for investment in Human Factors design process to improve safety and usability which leads to:
    – Increased potential sales (Competitive differentiator)
    – Reduced support costs (fewer complaints to handle)
    – Reduced development costs (Done right the first time)
    – Reduced training costs
    – Fewer field actions and recalls
Human Factors Core Methods

- **Contextual Inquiry**
  - User Profiles: *Who?*
  - Use Environment: *Where?*
  - Task Analysis: *What?*

- **Risk Analysis**
  - Estimate Risks

- **Usability Objectives**
  - Quantify Usability Performance

- **Iterative Design**
  - Rapid Prototyping
  - Simulations

- **Usability Testing**
  - Early with Simulations
  - Summative at the End
Goals for Human Factors

• Meeting all US and international regulations for HF
• Creating tools and training to enable development teams to implement best practice HF
• Assisting and guiding the execution of HF in product development and design controls
Human Factors Initiatives at Abbott

- Corporate HF Directors position with Executive Champions
- Human Factors Council (Internal sounding board group from each division)
- Expanded Operating Procedures describing HF methods
- HF Courses (Offered internally)
  - One day HF Overview
  - Workshops on Usability Testing and Use Error Risk Analysis
- Facilitating key projects to incorporate HF with:
  - Direct hands-on work
  - Managing work of consultants
  - Train and provide Usability Testing equipment to development teams
- Influence standards - Authors of HF Standards for Medical Devices – AAMI/ANSI (co-chair of HFE Committee), IEC/ISO (convener), AdvaMed
- Active dialog with FDA HF staff
Contact Information:

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+1 847 936 1131
Cindy Miller

Cindy has studied and worked in the field of human factors and engineering for over 15 years in a variety of regulated industries including aviation and healthcare. She has spear-headed human factors certification processes and instructed various human factors courses. Cindy works for GE Healthcare, leading efforts to incorporate human factors into design controls and risk management processes.
Agenda

- Introduction
- Design Controls
- Operationalizing
Introduction - GE Healthcare

• General Electric (GE)

• GEHC

• Regional P&L
  • US/Canada, Latin America, Asia-Pacific, China, EMEA, India
  • Presence in over 100 countries

• Product P&L
  • Surgery, Healthcare Systems, Life Sciences, Medical Diagnostics, Healthcare IT

• Key Areas of involvement
  • Cardiology, Neurology, Emergency Medicine, Oncology, Women’s Health
Introduction

• CFR Title 21 Part 820.30
• Standard IEC62366:2007
• AAMI HE75:2009
• FDA Guidance Document Draft June 2011
Design Controls
Title 21 CFR Part 820.30

Design Inputs (c)
- Requirements relating to a device are appropriate and address the intended use of the device, including the needs of the user and the patient

Design Outputs (d)
- Adequate evaluation of conformance to design input requirements
- Identify proper functioning of the device

Design Verification (f)
- Design outputs meet design inputs

Design Validation (g)
- Device conforms to user needs and intended uses

Design Reviews (e)
- Formal documented reviews of design results are planned and conducted at appropriate stages of device design development

IEC 62366

Section 5.1 Application Specification
- 5.2 Frequently Used Functions
- 5.4 Primary Operating Functions

Section 5.5 Usability Specification

Section 5.8 Verification

Sections 5.6/5.9 Validation Plan/Validation

Usability Activities part of formal design reviews

Title 21 CFR Part 820.30

IEC 62366
<table>
<thead>
<tr>
<th><strong>Usability Activities for each Formal Design Review</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gate 1</strong></td>
</tr>
<tr>
<td><strong>Planning &amp; Definition</strong></td>
</tr>
<tr>
<td><strong>Design Inputs</strong></td>
</tr>
<tr>
<td>• Review of Post-Market Data</td>
</tr>
<tr>
<td>• Literature Review</td>
</tr>
<tr>
<td>• Market Research</td>
</tr>
<tr>
<td>• Formative Testing:</td>
</tr>
<tr>
<td>• Observational Research</td>
</tr>
<tr>
<td>• Contextual Inquiry</td>
</tr>
<tr>
<td>• Heuristic Evaluation</td>
</tr>
<tr>
<td>• UI testing</td>
</tr>
<tr>
<td>• Many other usability testing methods</td>
</tr>
<tr>
<td>• Task/ Risk Analysis</td>
</tr>
<tr>
<td>• Development of User Requirements</td>
</tr>
<tr>
<td>• Repository Documentation for above work</td>
</tr>
<tr>
<td><strong>Design Outputs</strong></td>
</tr>
<tr>
<td>• Review Concepts / Prototyping</td>
</tr>
<tr>
<td>• Task/ Risk Analysis</td>
</tr>
<tr>
<td>• Decompose User Requirements into sub-system</td>
</tr>
<tr>
<td>requirements</td>
</tr>
<tr>
<td>• Repository Documentation for above work</td>
</tr>
<tr>
<td><strong>Risk Management</strong></td>
</tr>
<tr>
<td>• Identification of Use Error with Task Analysis and Formative Testing</td>
</tr>
<tr>
<td>• Determining mitigation of Use Error</td>
</tr>
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<td><strong>Gate 2</strong></td>
</tr>
<tr>
<td><strong>Design Development &amp; Design Verification</strong></td>
</tr>
<tr>
<td><strong>Design Inputs</strong></td>
</tr>
<tr>
<td><strong>Design Outputs</strong></td>
</tr>
<tr>
<td><strong>Design Verification</strong></td>
</tr>
<tr>
<td>• Design Review</td>
</tr>
<tr>
<td>• Formative Usability Testing:</td>
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<tr>
<td>• Cognitive Walkthrough</td>
</tr>
<tr>
<td>• Other methods</td>
</tr>
<tr>
<td><strong>Gate 3</strong></td>
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<tr>
<td><strong>Design Transfer &amp; Design Validation</strong></td>
</tr>
<tr>
<td><strong>Design Inputs</strong></td>
</tr>
<tr>
<td><strong>Design Outputs</strong></td>
</tr>
<tr>
<td><strong>Design Verification</strong></td>
</tr>
<tr>
<td>• Summative Usability Testing</td>
</tr>
<tr>
<td>• Acceptance Criteria using performance measures</td>
</tr>
<tr>
<td><strong>Risk Management</strong></td>
</tr>
<tr>
<td>• Implementation &amp; Verification of Mitigations for use error</td>
</tr>
<tr>
<td>• Validation of mitigations for use errors</td>
</tr>
</tbody>
</table>
Operationalizing

- Internal procedure
- Templates
- Checklists
- Resources
  - Identifying SMEs
  - Usability Domain Expertise
  - Clinical Domain Expertise
- Community of Practice
- Examples
- Best Practices
- Training courses
  - Instructor Led
  - eLearning
Sample Sharing Website

Process Information
- Process Flowchart
- Frequently Asked Questions
- Reference Material
  - Please Select

Training
- Training Courses
  - Please Select
- Documentation
  - Please Select

People
- Charter
- Membership
- Roles and Responsibilities

Useful Links
- Professional Organizations
  - Please Select

Resources
- Templates/Checklists
  - Please Select
- Mentoring program
- External Training

Best Practices
- Best Practices
  - Please Select

Contact Us
- Facilitator
- Co-Facilitator
Sample Deep Domain Wiki

Welcome

Blog Posts

Library

Articles

UI Examples
Eric Bergman

Eric is Director of Human Factors Engineering for Johnson & Johnson’s Diabetes Care Franchise. His team supports development of blood glucose meters, insulin pumps and associated products. Prior to J&J, Eric consulted on medical product usability, and served as a user experience architect, interaction designer, and Human Factors Engineer at Sun Microsystems, PalmSource, and HP.
Human Factors Engineering at J & J’s Diabetes Care Franchise

Eric Bergman, Ph.D.
Director, Human Factors Engineering
LifeScan, Inc (a Johnson & Johnson Company)

Symposium on Human Factors & Ergonomics in Health Care
Baltimore, MD
March 2011
• World’s most comprehensive and broadly based health care products company

• Celebrating 125 years

• 250 operating companies in over 60 countries

• Over 110,000 employees
My Perspective

Director of Human Factors Team at the Johnson & Johnson Diabetes Care Franchise

Worldwide operating locations include:

- Milpitas, CA
- West Chester/Wayne, PA
- Inverness, Scotland
- As well as a number of other sites around the world...
Diabetes is a group of metabolic diseases characterized by hyperglycemia (high blood sugar)

Resulting hyperglycemia, if untreated, may lead to long-term complications and immediate issues

Billions and billions of blood tests
- ≈16 billion tests annually
- ≈44 million tests daily

~38 million on insulin; ~700,000+ patients use pumps
Why Human Factors?

- Improve patient/user safety
  - Improve outcomes
  - Reduce adverse events

- Meet regulatory requirements
  - Increasing FDA focus on human factors and use error
  - National & international standards

- Competitive edge via superior usability
  - Design it right – improve usability beyond safety
  - Satisfy existing customers & attract new customers
  - Reduce costs of training, support, and related activities
Our Credo

We believe our first responsibility is to the doctors, nurses and patients, to mothers and fathers and all others who use our products and services. In meeting their needs everything we do must be of high quality. We must constantly strive to reduce our costs in order to maintain reasonable prices. Customers’ orders must be serviced promptly and accurately. Our suppliers and distributors must have an opportunity to make a fair profit.

We are responsible to our employees, the men and women who work with us throughout the world. Everyone must be considered as an individual. We must respect their dignity and recognize their merit. They must have a sense of security in their jobs. Compensation must be fair and adequate, and working conditions clean, orderly and safe. We must be mindful of ways to help our employees fulfill their family responsibilities. Employees must feel free to make suggestions and complaints. There must be equal opportunity for employment, development and advancement for those qualified.

We must provide competent management, and their actions must be just and ethical. We are responsible to the communities in which we live and work and to the world community as well. We must be good citizens -- support good works and charities and bear our fair share of taxes. We must encourage civic improvements and better health and education. We must maintain in good order the property we are privileged to use, protecting the environment and natural resources.

Our final responsibility is to our stockholders. Business must make a sound profit. We must experiment with new ideas. Research must be carried on, innovative programs developed and mistakes paid for. New equipment must be purchased, new facilities provided and new products launched. Reserves must be created to provide for adverse times. When we operate according to these principles, the stockholders should realize a fair return.

Written by General Robert Wood Johnson

Visionary and U.S. business leader

Among the first to speak openly of a company’s responsibility

Part of organization for over 65 years

Symposium on Human Factors & Ergonomics in Health Care (Eric Bergman, March 2012)
We believe our first responsibility is to the doctors, nurses and patients, to mothers and fathers and all others who use our products and services.

In meeting their needs everything we do must be of high quality.

We must constantly strive to reduce our costs in order to maintain reasonable prices.

Customers’ orders must be serviced promptly and accurately.

Our suppliers and distributors must have an opportunity to make a fair profit.
As well as...

- Diabetes management software (Patient & HCP)
- Health care professional training and support
- Patient guidance and support

“Consumer” users make human factors especially relevant, but it is equally important for expert use – more on that later...

Symposium on Human Factors & Ergonomics in Health Care (Eric Bergman, March 2012)
Currently reside in Quality
Work directly with R&D teams (who are also growing capabilities in UI Design & ID)
Develop HF process and templates
Direct 3\textsuperscript{rd}-party consultants
Collaborate w/R&D, Clinical, Marketing & others
Represent J&J on AAMI HFE committee
Partner with business development
And more...
Human Factors Related Initiatives

HF Repository for Diabetes Care Franchise
- Will contain HF documents organized by project & topic

J&J “Community of Practice”
- Monthly forum
- Aligning human factors processes & best practices
- Developing shared training & shared repository

Design Summit
- J&J internal meeting on HF/ID
- Opportunity to network/share best practices
Thank You

Eric Bergman, Ph.D.
Director, Human Factors Engineering
LifeScan, Inc (a Johnson & Johnson Company)
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Milpitas, CA  95035

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Merrick Kossack

Merrick has studied and worked in the field of human factors for over 20 years. During his career, he has introduced, championed, and institutionalized human factors engineering processes and techniques. He has also taught courses on human factors in medical device development. Merrick works for Intuitive Surgical, makers of the da Vinci surgical robot system, leading efforts to introduce human factors into their established development processes.
Intuitive Human Factors

2012 Symposium on Human Factors and Ergonomics in Health Care: Bridging the Gap

March 13, 2012

Merrick Kossack
Sr. Human Factors Engineer
da Vinci Si Surgical System
Engineering Organization

- Systems Analysis
- Electrical
- Mechanical
- Product Development
- Software
- Test Engineering
Product Development

- Technical Product Management
- Clinical Engineering
- Human Factors
- Interaction Design
- Industrial Design

User Centered
Keys to HF Success

*Culture*

*Educate: What is it, why do it, and how do you do it?*

*Continue Collaboration*

*Set Expectations*

*Grow Capabilities*

*Establish Processes*
Thank you

Merrick Kossack
Sr. Human Factors Engineer
Intuitive Surgical, Inc.
Sunnyvale, CA

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Bonnie Hautamaki

Bonnie has worked in the field of human factors for over 15 years. She currently works at McKesson Provider Technologies doing User Interface Design and Human Factors Engineering work on medical and pharmaceutical software applications. Her previous experience in the Human Factors field includes Hewlett-Packard Co., Agilent Technologies, and Micro Analysis & Design. Her interests include user interface design, usability, process design & analysis, and assessing user needs.
Human Factors Engineering @ McKesson Provider Technologies

Electronic Health Records

March 2012
Bonnie Hautamaki
Senior Human Factors Engineer
Electronic Health Records
One Patient – Many Caregivers & Locations – Much Data

Emergency Dept: Patient demographics, admission assessment, vitals, pt history, allergies, home meds, physician orders and documentation, med, lab and rad orders
Electronic Health Records
One Patient – Many Caregivers & Locations – Much Data

- **Radiology:** Imaging orders, results, patient documentation
- **Lab:** Lab orders, results, patient documentation
- **Pharmacy:** medication orders, patient history, allergies, medication history, medications, IVs
Patient room: Vitals, admission assessment, allergies, pt history, med orders, med & IV administrations, physician and nursing orders, lab/rad orders and results, ancillary documentation (PT, RT)
Electronic Health Records
One Patient – Many Caregivers & Locations – Much Data

Patient Discharge: Discharge instructions, prescriptions, medication lists
Electronic Health Records
One Patient – Many Caregivers & Locations – Much Data

Med room: Med orders, Med Administration Record, patient chart, meds, IVs

Patient room: Vitals, admission assessment, allergies, pt history, med orders, med & IV administrations, physician and nursing orders, lab/rad orders and results, ancillary documentation (PT, RT)

Ready for discharge: Patient documentation, discharge orders, medication reconciliation, discharge prescriptions

Admission: Patient demographics & billing info

Nursing stations: Patient documentation, vitals, patient history, allergies, orders, Medication Administration Record, ancillary (lab/rad) results, physician orders and documentation

Pharmacy: medication orders, patient history, allergies, medication history, medications, IVs

Emergency Dept: Patient demographics, admission assessment, vitals, pt history, allergies, home meds, physician orders and documentation, med, lab and rad orders

Radiology: Imaging orders, results, patient documentation

Lab: Lab orders, results, patient documentation

Patient Discharge: Discharge instructions, prescriptions, medication lists
Challenges for Users

- Hospital Environment:
  - Many interruptions
  - Noise, alarms, distractions, low light
  - Constant time pressure
  - Collaboration required
    - Many people caring for same patient
    - Handoffs of patient care and data
    - Every caregiver plays a part in the outcome
  - Decisions & actions have high impact (and risk)
- To our users, the computer is not the focus of their work – it should be an “invisible tool”
Challenges for UI Designers

Context of Use

- Multiple users of same applications & data (RNs, Physicians)
- Understand complex tasks and clinical workflows for each user role
- Conduct user research in a heavily regulated environment (e.g. privacy)
- Complexities engaging end-users for user testing

Business Issues

- Integration of legacy systems (from various sources); our goal to create a seamless experience
- Educating a large base of engineers and product owners about merits of Human Factors Engineering & User-Centered Design

Government regulations - provides some support, some challenges
The McKesson Clinicals HFE Group

- Manager; 2 researchers; 9 designers

- Primary Tasks:
  - Educate
  - Define tools (templates) & processes (UCD)
  - Use the tools & processes as we design products
Critical Success Factors
Education of Stakeholders

- Ourselves
  - About the end user (user research)
  - About industry practices, regulations, etc.
  - About products and designs our colleagues are working on (weekly HFE team design reviews)

- Project teams – about User-Centered Design
  - User Interface training classes
  - Collection of UI standards, tools and best practices

- Others in the organization
  - Monthly HFE educational meetings (corporate-wide)

- Anyone – Informal educational opportunities may come with any conversation
Critical Success Factors
Definition of Tools and Processes

- **Tools**
  - User Interface standards
  - Templates (Visio, etc.)

- **Processes**
  - User Research
  - User-Centered Design
  - How/when to engage with project teams
  - Agile methods

- **SharePoint site to make tools & processes accessible**
Critical Success Factors
Use of Tools and Processes

% HFE time – two sample days

- UI Standards & patterns
- User testing
- Visual design
- Project meetings
- Administrative
- Other strategic work
- Team meetings
- Fighting fires
- Educating ourselves
- UI quality control
- Educating others
# Design Iteration 1: Information Architecture

## Home Meds

### Antimicrobials

<table>
<thead>
<tr>
<th>Med</th>
<th>Dose</th>
<th>Route</th>
<th>Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medone, Low Dose</td>
<td>81 MG</td>
<td>Oral</td>
<td>Daily</td>
</tr>
<tr>
<td>Medtwo (Brandtwo)</td>
<td>50 MG</td>
<td>Oral</td>
<td>Daily</td>
</tr>
<tr>
<td>Medicationthiazide</td>
<td>25 MG</td>
<td>Oral</td>
<td>Daily</td>
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<tr>
<td>Medication</td>
<td>81 MG</td>
<td>Oral</td>
<td>Daily</td>
</tr>
<tr>
<td>Generic (Brandname)</td>
<td>50 MG</td>
<td>Oral</td>
<td>Daily</td>
</tr>
<tr>
<td>Medone, Low Dose</td>
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<tr>
<td>Medicationthiazide</td>
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</table>

## Inpatient Meds

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<th>Med</th>
<th>Dose</th>
<th>Route</th>
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<tbody>
<tr>
<td>Generic (Brandname)</td>
<td>50 MG</td>
<td>Oral</td>
<td>Daily</td>
</tr>
<tr>
<td>Medtwo (Brandtwo)</td>
<td>50 MG</td>
<td>Oral</td>
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<td>Oral</td>
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<tr>
<td>Generic (Brandname)</td>
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## Cardiovascular

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<td>Medone, Low Dose</td>
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<td>Oral</td>
<td>Daily</td>
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<tr>
<td>Medtwo (Brandtwo)</td>
<td>50 MG</td>
<td>Oral</td>
<td>Daily</td>
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<tr>
<td>Medicationthiazide</td>
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<td>Oral</td>
<td>Daily</td>
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## GI Meds

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<tbody>
<tr>
<td>Medication</td>
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<td>Oral</td>
<td>Daily</td>
</tr>
<tr>
<td>Medication</td>
<td>81 MG</td>
<td>Oral</td>
<td>Daily</td>
</tr>
<tr>
<td>Generic (Brandname)</td>
<td>50 MG</td>
<td>Oral</td>
<td>Daily</td>
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</table>
Design Iteration 2: Medication List Details

### Home Meds

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<tr>
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<th>Route</th>
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<th>Class</th>
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<tbody>
<tr>
<td>H</td>
<td>Prednisone</td>
<td>5 MG</td>
<td>Oral</td>
<td>QOD Corticosteroids</td>
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<tr>
<td>H</td>
<td>Digoxin</td>
<td>0.25 MG</td>
<td>Oral</td>
<td>Daily None</td>
</tr>
<tr>
<td>H</td>
<td>Glucosamine/Chondroitin</td>
<td>750/100 MG</td>
<td>Oral</td>
<td>BID None</td>
</tr>
<tr>
<td>H</td>
<td>Atenolol</td>
<td>25 MG</td>
<td>Oral</td>
<td>Daily B-Adrenergic Agents</td>
</tr>
<tr>
<td>H</td>
<td>Captopril/Hydrochlorothiazide</td>
<td>12.5/25 MG</td>
<td>Oral</td>
<td>Daily Angiotensin-Converting Enzyme Inhibitors</td>
</tr>
<tr>
<td>H</td>
<td>Captopril/Hydrochlorothiazide</td>
<td>12.5/25 MG</td>
<td>Oral</td>
<td>Daily Thiazide Diuretics</td>
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<tr>
<td>H</td>
<td>Aspirin</td>
<td>81 MG</td>
<td>Oral</td>
<td>Daily Salicylates</td>
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<tr>
<td>H</td>
<td>Aspirin</td>
<td>81 MG</td>
<td>Oral</td>
<td>Daily Platelet-Aggregation Inhibitors</td>
</tr>
<tr>
<td>H</td>
<td>Aspirin</td>
<td>81 MG</td>
<td>Oral</td>
<td>Daily Thromobolytic Agents</td>
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<tr>
<td>H</td>
<td>Atorvastatin</td>
<td>10 MG</td>
<td>Oral</td>
<td>Daily HMG-CoA Reductase Inhibitors</td>
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<tr>
<td>H</td>
<td>Acetaminophen</td>
<td>650 MG</td>
<td>Oral</td>
<td>Q6H PRN Analgesics and Antipyretics, Miscellaneous</td>
</tr>
<tr>
<td>H</td>
<td>Famotidine</td>
<td>10 MG</td>
<td>Oral</td>
<td>BID Antilulcer Agents and Acid Suppressant</td>
</tr>
<tr>
<td>H</td>
<td>Naproxen</td>
<td>250 MG</td>
<td>Oral</td>
<td>TID Nonsteroidal Anti-inflammatory Agents</td>
</tr>
<tr>
<td>H</td>
<td>Clonidine</td>
<td>0.1 MG</td>
<td>Oral</td>
<td>Daily a-Adrenergic Blocking Agents</td>
</tr>
<tr>
<td>H</td>
<td>Monoleukast</td>
<td>10 MG</td>
<td>Oral</td>
<td>QHS Leukotriene Modifiers</td>
</tr>
<tr>
<td>H</td>
<td>Duloxetine</td>
<td>60 MG</td>
<td>Oral</td>
<td>Daily Antidepressants</td>
</tr>
</tbody>
</table>

### Inpatient Meds

<table>
<thead>
<tr>
<th>Med</th>
<th>Dose</th>
<th>Route</th>
<th>Freq</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Albuterol</td>
<td>2 puffs</td>
<td>Oral</td>
<td>Q6H PRN Adrenergic Agents</td>
</tr>
<tr>
<td>I</td>
<td>Cefuroxime</td>
<td>750 MG</td>
<td>IV</td>
<td>Q12HR Cephalosporins</td>
</tr>
<tr>
<td>I</td>
<td>Gentamicin</td>
<td>240 MG</td>
<td>IV</td>
<td>Q24HR Aminoglycosides</td>
</tr>
</tbody>
</table>
**Design Iteration 3:**
**Test a Workflow**

### Discharge Medication Reconciliation

**Group By:** Therapeutic Class (Alphabetical)

#### Home Meds

<table>
<thead>
<tr>
<th>Med</th>
<th>Actions</th>
<th>Med</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiotensin-Converting Enzyme Inhibitors</td>
<td></td>
<td>Angiotensin-Converting Enzyme Inhibitors</td>
<td></td>
</tr>
<tr>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td>R M D/C</td>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td>R M D/C</td>
</tr>
<tr>
<td>Salicylates</td>
<td></td>
<td>Salicylates</td>
<td></td>
</tr>
<tr>
<td>Aspirin</td>
<td></td>
<td>Aspirin</td>
<td></td>
</tr>
<tr>
<td>81 MG, Oral, Daily</td>
<td></td>
<td>81 MG, Oral, Daily</td>
<td></td>
</tr>
<tr>
<td>Naproxen (Naprosyn)</td>
<td></td>
<td>Nonsteroidal Anti-inflammatory Agents</td>
<td></td>
</tr>
<tr>
<td>250 MG, Oral, TID</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analgesics and Antipyretics, Miscellaneous</td>
<td></td>
<td>Analgesics and Antipyretics, Miscellaneous</td>
<td></td>
</tr>
<tr>
<td>Acetaminophen (Tylenol)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 MG, Oral, Q6H PRN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thiazide Diuretics</td>
<td></td>
<td>Thiazide Diuretics</td>
<td></td>
</tr>
<tr>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td></td>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td></td>
</tr>
<tr>
<td>Opiate Agonists</td>
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<td>Opiate Agonists</td>
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</table>

#### Inpatient Meds

<table>
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<th>Actions</th>
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</tr>
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<td>R M D/C</td>
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</tr>
<tr>
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<td>Salicylates</td>
<td></td>
</tr>
<tr>
<td>Aspirin</td>
<td></td>
<td>Aspirin</td>
<td></td>
</tr>
<tr>
<td>81 MG, Oral, Daily</td>
<td></td>
<td>81 MG, Oral, Daily</td>
<td></td>
</tr>
<tr>
<td>Naproxen (Naprosyn)</td>
<td></td>
<td>Nonsteroidal Anti-inflammatory Agents</td>
<td></td>
</tr>
<tr>
<td>250 MG, Oral, TID</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analgesics and Antipyretics, Miscellaneous</td>
<td></td>
<td>Analgesics and Antipyretics, Miscellaneous</td>
<td></td>
</tr>
<tr>
<td>Acetaminophen (Tylenol)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>650 MG, Oral, Q6H PRN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thiazide Diuretics</td>
<td></td>
<td>Thiazide Diuretics</td>
<td></td>
</tr>
<tr>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td></td>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td></td>
</tr>
<tr>
<td>Opiate Agonists</td>
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<td>Opiate Agonists</td>
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</table>

#### Working List

<table>
<thead>
<tr>
<th>Med</th>
<th>Actions</th>
<th>Med</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiotensin-Converting Enzyme Inhibitors</td>
<td></td>
<td>Angiotensin-Converting Enzyme Inhibitors</td>
<td></td>
</tr>
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<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td>R M D/C</td>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td>R M D/C</td>
</tr>
<tr>
<td>Salicylates</td>
<td></td>
<td>Salicylates</td>
<td></td>
</tr>
<tr>
<td>Aspirin</td>
<td></td>
<td>Aspirin</td>
<td></td>
</tr>
<tr>
<td>81 MG, Oral, Daily</td>
<td></td>
<td>81 MG, Oral, Daily</td>
<td></td>
</tr>
<tr>
<td>Naproxen (Naprosyn)</td>
<td></td>
<td>Nonsteroidal Anti-inflammatory Agents</td>
<td></td>
</tr>
<tr>
<td>250 MG, Oral, TID</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analgesics and Antipyretics, Miscellaneous</td>
<td></td>
<td>Analgesics and Antipyretics, Miscellaneous</td>
<td></td>
</tr>
<tr>
<td>Acetaminophen (Tylenol)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 MG, Oral, Q6H PRN</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Thiazide Diuretics</td>
<td></td>
<td>Thiazide Diuretics</td>
<td></td>
</tr>
<tr>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td></td>
<td>Captopril/Hydrochlorothiazide (Capotizde)</td>
<td></td>
</tr>
<tr>
<td>Opiate Agonists</td>
<td></td>
<td>Opiate Agonists</td>
<td></td>
</tr>
</tbody>
</table>

**View One-Time/Stat Meds**

**View Emergency Department Meds**
Design Iteration 4: Comparison Test – 2 Layouts

Two Pane

Three Pane
### Allergy History

- Adhesive Tape
- Amoxicillin
- Shellfish

### Home & Inpatient Meds

<table>
<thead>
<tr>
<th>Medication</th>
<th>Type</th>
<th>Dose</th>
<th>Route</th>
<th>Freq/Rate</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cephalosporins</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Cefuroxime (Znoace) - Unverified</td>
<td>Inpatient</td>
<td>750 MG</td>
<td>IV</td>
<td>Q12H</td>
<td>Cont</td>
</tr>
<tr>
<td><strong>HMG-CoA Reductase Inhibitors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pravastatin (Pravachol)</td>
<td>Home</td>
<td>80 MG</td>
<td>Oral</td>
<td>Daily</td>
<td>Ord</td>
</tr>
<tr>
<td>Atorvastatin (Lipitor)</td>
<td>Inpatient</td>
<td>10 MG</td>
<td>Oral</td>
<td>Daily</td>
<td>Cont</td>
</tr>
<tr>
<td><strong>Beta-adrenergic blocker</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atenolol (Tenormin)</td>
<td>Home</td>
<td>25 MG</td>
<td>Oral</td>
<td>BID</td>
<td>Ord</td>
</tr>
<tr>
<td>Atenolol (Tenormin) - Unverified</td>
<td>Inpatient</td>
<td>50 MG</td>
<td>Oral</td>
<td>BID</td>
<td>Cont</td>
</tr>
<tr>
<td><strong>Benzodiazepines</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alprazolam (Lorazepam) - Unconfirmed</td>
<td>Home</td>
<td>0.5 MG</td>
<td>Oral</td>
<td>BID</td>
<td>Ord</td>
</tr>
</tbody>
</table>

### Working List

- **Medication**
  - Alprazolam (Lorazepam) - Unconfirmed
    - 0.5 MG, Oral, BID
  - Atenolol (Tenormin) - Unverified
    - 50 MG, Oral, BID
  - Atorvastatin (Lipitor)
    - 10 MG, Oral, Daily
  - Cefuroxime (Znoace) - Unverified
    - 1000 MG, IV, Q12H
  - DiltaZem (Cardizem) - Unconfirmed
    - 120 MG, Oral, Daily
  - Fluticasone-Salmeterol (Advair Diskus) - Unverified
    - 1 Puff, Inhalation, BID
Success –
In the words of our users...

I almost did a little happy dance. Very cool application.

It's not cluttered, it's real simple, and it's right there.

I really like this display. It is really easy to read.

Very intuitive compared to the learning curve of HEO.

It is obvious you guys listened to us.
Thank you!

Bonnie Hautamaki
Senior Human Factors Engineer
McKesson Provider Technologies
Westminster, CO
Bonnie.Hautamaki@McKesson.com
Thanks to the Panelists

Ed Israelski
Cindy Miller
Eric Bergman
Merrick Kossack
Bonnie Hautamaki

Moderator and facilitator
Rob Albert
Ed Madigan