
User Centered Design:

Designing usable software

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Overview

- **Meaningful Use 2 and UCD**
- **Define usability, user experience and UCD**
- **Provide an overview of UCD processes & methods**
- **Provide some illustrations of effects of UCD on UI design**

Meaningful Use (MU) Criteria

- The use of a certified EHR in a meaningful manner by both doctors (EPs) & healthcare facilities (EHs)
- Need to use a ONC “certified” EHR technology
- MU criteria implemented in three Stages over 6 years – in each Stage, specific usage requirements must be demonstrated to meet MU criteria
- Focus today on “safety enhanced design” requirements (CFR 170.314 (g)(3))
 - For Stage 2, only covers 8 medication-related functions

MU and HIT Usability

- **Physicians and others complained about EHR usability impairing ability to meet MU criteria**
- **ONC asked NIST to develop methods to assess EHR usability for MU certification**
- **Two aspects for Stage 2 MU certification:**
 - **Attest to use of User-Centered Design (UCD) in development of relevant medication applications**
 - **Conduct quantitative summative usability of the relevant applications (e.g., RxStar, AdminRx, etc.)**

Users' HIT Design Priorities

- HIT as a true partner in care – acting as a reliable “friend” and effective communicator
- Support patient-centered, personalized care
- Support distributed care (people, space, & time)
- Foster high quality care (effective, safe, efficient)
- Documentation as a byproduct of care (not as a separate, distracting, or inefficient task)

User interface



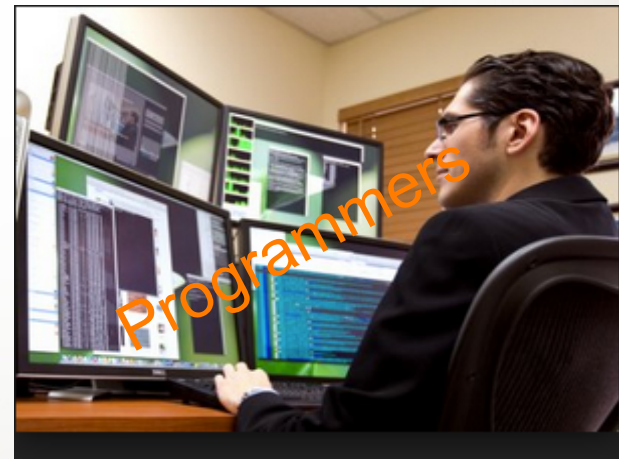
Means for shaping behavior



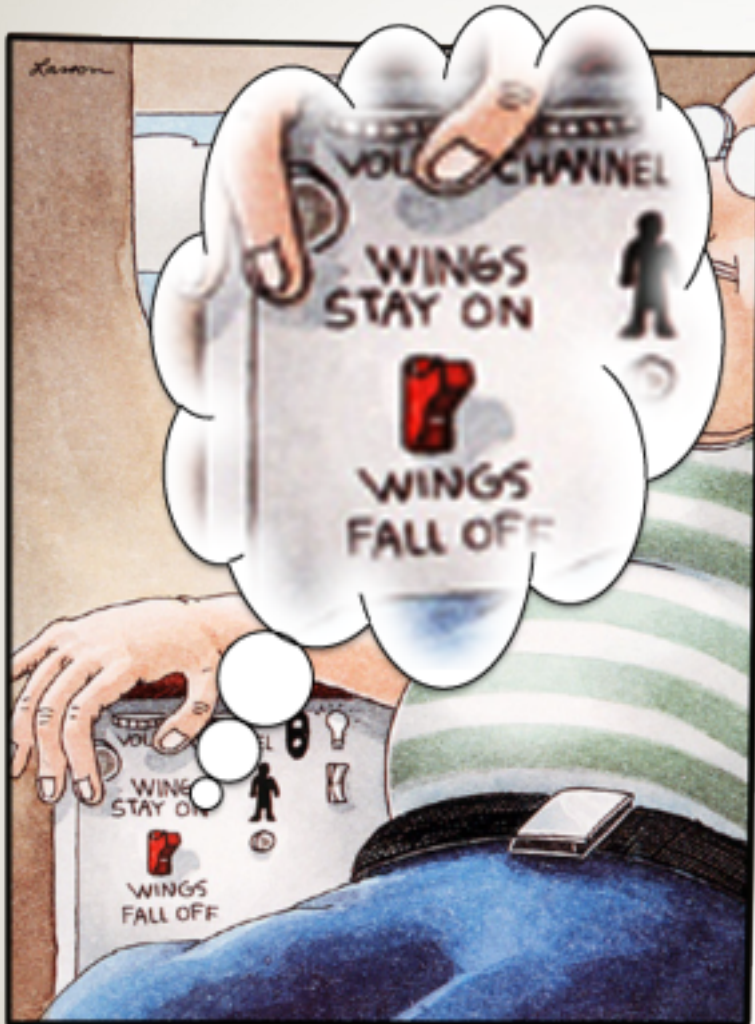
Means for achieving goals



Means for achieving consensus



Represents backend system



Fumbling for his recline button, Ted unwittingly instigates a disaster.

The User Interface

- Any aspect of a system, process, or device with which a human can interact.
- Includes software, hardware, documentation, labeling and packaging.
- Users include clinicians, cleaning personnel, maintainers, patients, lay persons, programmers etc.

Usability

- **A characteristic of systems that allows:**
 - Specified users, in a
 - Specific context of use
 - To achieve goals and tasks
- **Efficiently (in a timely manner)**
- **Effectively (accurately)**
- **With Satisfaction (absence of frustration / engagement / delight)**

User Experience (UX)

“All aspects of a user’s interaction with a company, its services, and its products.”

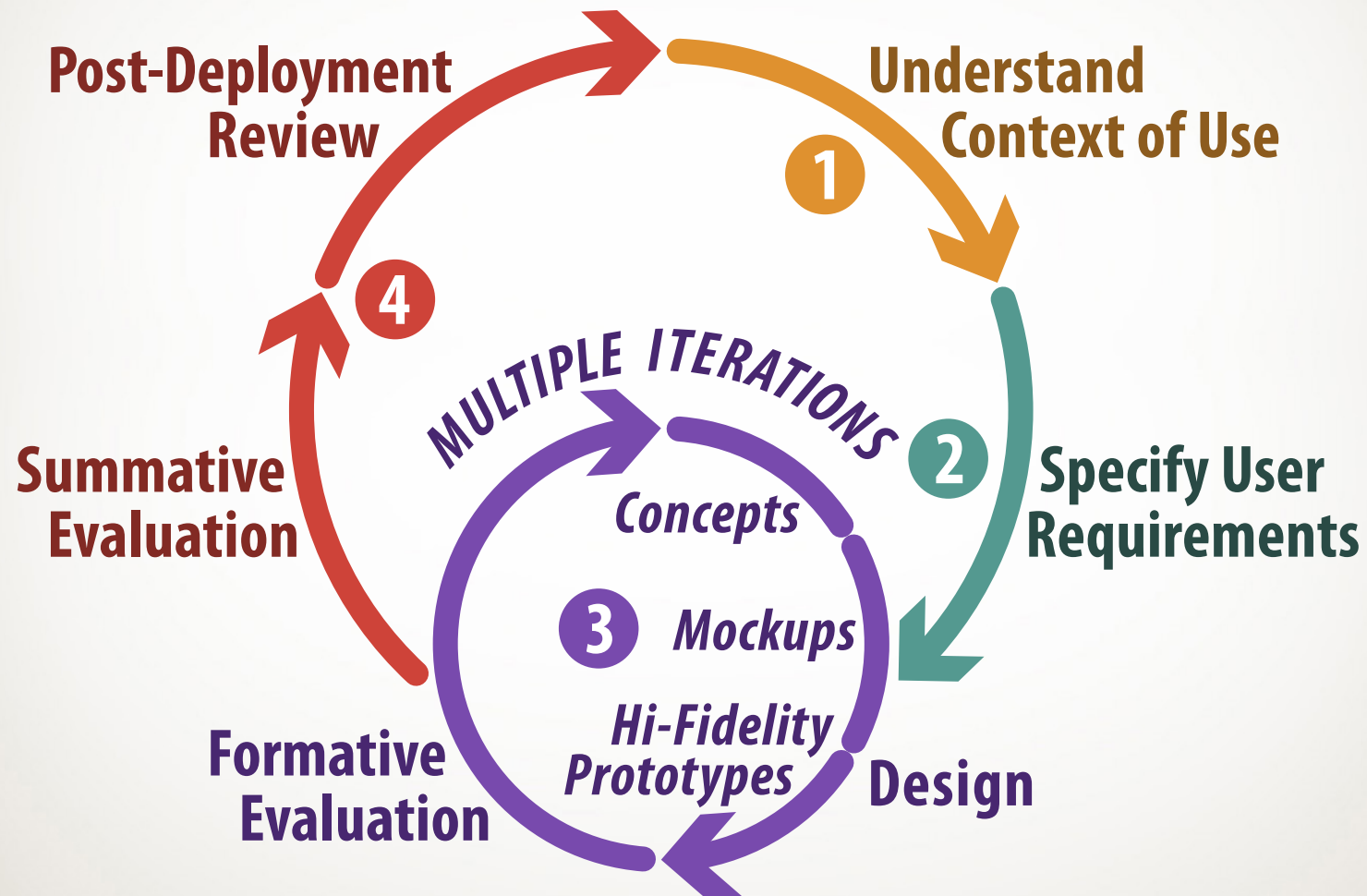
Principles:

1. Meets customer’s exact needs without fuss or bother.
2. Simplicity & elegance in products that are a joy to own & use.
3. Surpasses what customers say they want; more than providing checklist features.
4. Seamless merging of multiple disciplines: engineering, marketing, graphical & industrial design, human factors, interface and interaction design.

Jacob Neilson



User Centered Design



From ISO 9241:210 Human-centered design for interactive systems

User-Centered Design: ISO 9241:210

Understand & Specify the context of use

Describe Context of use: describe the physical, social and technological features of the environment. Describe users' goals & constraints; relevant user characteristics; identify user tasks & relevant risks (tasks not described only in terms of features/ functions).

Different contexts of use:

Life Critical Systems – aviation, nuclear power, anesthesia

Industrial & Commercial – accounting, management, law, sales, finance.

Home & entertainment – games, relaxation, DIY, hobbies?

Exploratory, creative and collaborative – architecture, music video editing, social media of all types. *Schneiderman & Plaisant, 2010*

User-Centered Design: ISO 9241:210

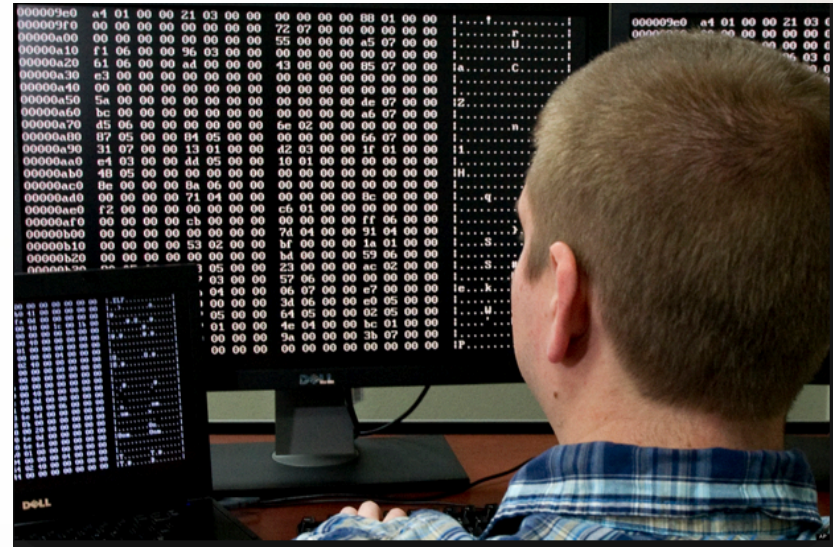
Work in 1940s



Behavioral task analysis

Observable,
Physical,
Sequenced
Physical task-space

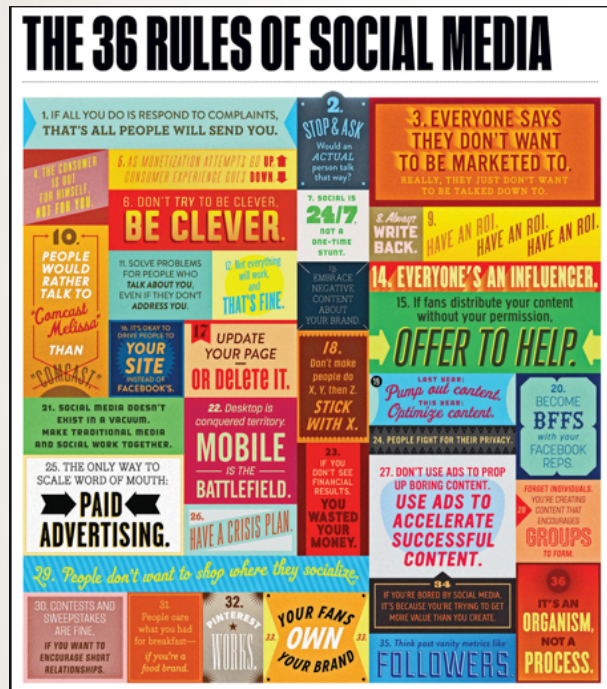
Work in 2020s



Cognitive task analysis

Inferable,
Abstract,
Non-linear
Information space

User-Centered Design: ISO 9241-210



Collaborative task analysis?
Understanding social spaces



Personal computing?
Understand personal
information spaces

User-Centered Design: ISO 9241-210

Specify the user requirements

UCD extends functional req. to define user needs. Includes: Measureable performance/satisfaction criteria; organizational/regulatory constraints → basis for design & evaluation. Relevant UI standards/guidelines; Resolve conflicts b/w requirements. Verify & agree across stakeholders.

Multiple methods especially direct observations & cognitive interviews

- Representative users ... *not only super-users*
- Users' goals ... *not only tasks*
- Work as Done ... *not Work as Imagined*
- Elicit needs ... *not wants*

Wants vs. Needs



Current state of transportation in 1908 What Ford built

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Produce
design
solutions

Design user interaction, **NOT** what the UI looks like! Design user-system interaction to meet user req. considering UX; make solutions concrete using scenarios/simulation, mockups & prototypes;

Design user interaction, **NOT** what the UI looks like!

- Navigational frameworks
- Information architecture
- Design guidelines and standards based on human capabilities

Principles:

- fit with goals/tasks; self-descriptive & learnable;
- conforms to user expectations;
- controllable,
- error prevention & forgiveness,
- individualizable.

It's *not* about making the UI pretty

Example: Decision support for pressure ulcers

PU Risk Pressure Ulcer

PRESSUREULCER

Pressure Ulcers Documented:

Add Save Edit Clear Save to File Delete Cancel

Scant Small Moderate Heavy Discharge Character Bloody Cloudy Purulent Serosanguinous Serous Viscous Wound Discharge Odor None Foul

Black Blue Brown Colorless Clay Green Maroon Orange Pink Red Tan Violet White Yellow

Fibrinous Granulating Hypergranulization Necrotic Slough Smooth Percent Necrotic 0 <= 25% >25%

Suspected Deep Tissue Inj. Pressure Ulcer Stage I Pressure Ulcer Stage II Pressure Ulcer Stage III Pressure Ulcer Stage IV Pressure Ulcer Unstageable

Bactericidal Bacteriostatic Cadexomer Iodine Collagen Dilute Sodium Hypochlorite Enzymatic Ointment Petrolatum Porcine Submucosa Silver Silver Sulfadiazine Prevention Device Elbow Pad Foam Air Heel Elevator Heel Lift Heel Pillow Inflatable Heel Lift Rigid Heel Splint Eat more food

Antimicrobial Disk Balsam of Peru Bismuth Gauze Calcium Alginate Foam Dressing Gauze Gauze Packing Gauze Wrap Hydrocolloidal Hydrogel Hypertonic Hydrogel Pressure Transparent

Close Options Preview Save Send for Signature Send for Review Done!

Before usability testing:

“Where do I find...”

High levels inefficiency & dissatisfaction

PU Risk Pressure Ulcer

PRESSUREULCER

Choose Ulcer Location

Add Summary of Pressure Ulcers Update Last < Delete Ulcer Entry < Update Ulcer

Sacrum/Coccyx Heel Lateral Left Heel Lateral Right Heel Left Heel Medial Left Heel Medial Right Heel Right Ischial Tuberosity Left Ischial Tuberosity Right Trochanter Left Trochanter Right Ear Left Ear Right Elbow Left Elbow Right Forehead Knee Left Knee Right Lateral Malleolus Left Lateral Malleolus Right Medial Malleolus Left Medial Malleolus Right Occiput Scapula Left Scapula Right Scrotum Tracheostomy

Routine Assessment Measures: Length Width Depth Wound Bed Color: Black Gray Green Pink Red Tan White Yellow Wound Discharge: None Scant Small Moderate Heavy Wound Odor: None Foul

Detailed Assessment Induration: None Limited To Wound Extends Into Periound <1 cm Extends Into Periound >1 cm Erythema: None Extends Into Periound <1 cm Extends Into Periound >1 cm Limited To Wound Swelling: None Limited To Wound Extends Into Periound <1 cm Extends Into Periound >1 cm Fluctuant

Wound Temperature: Consistent With Body Temperature Warmer Than General Body Temperature Visible Structures: Bone Tendon Muscle Discharge Character: Bloody Cloudy

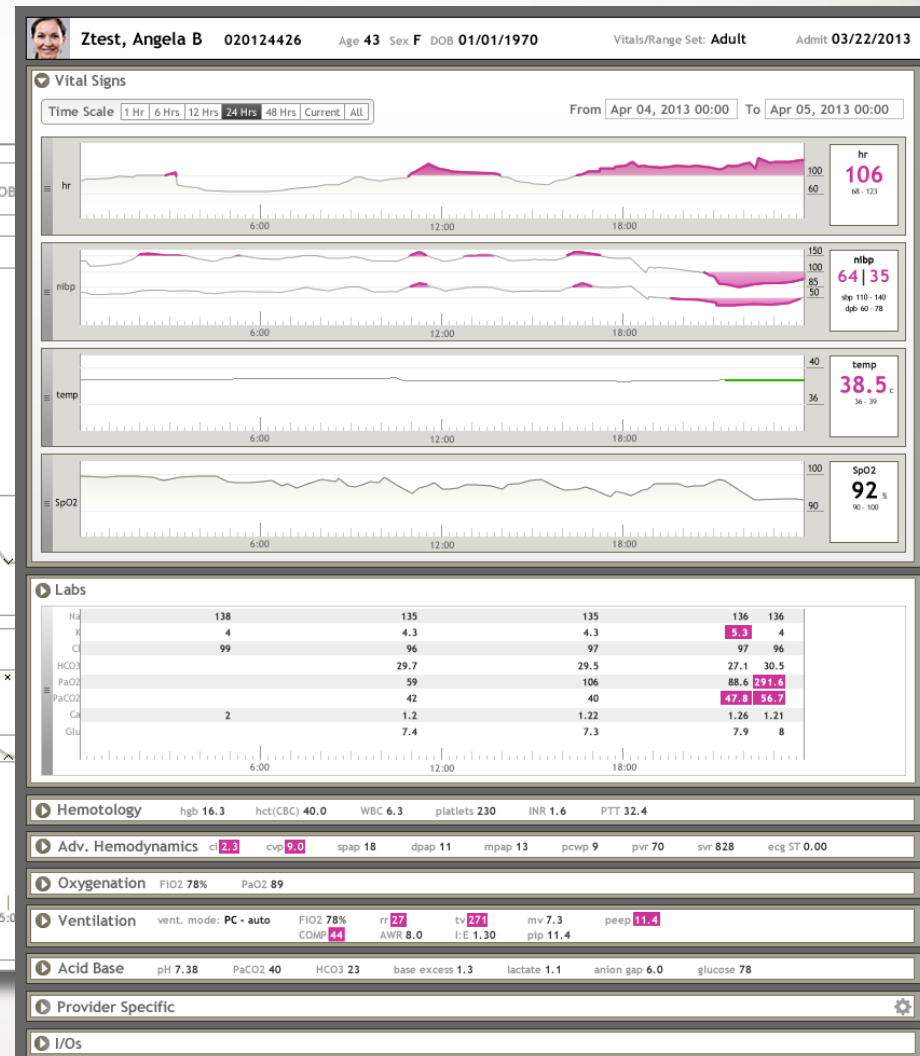
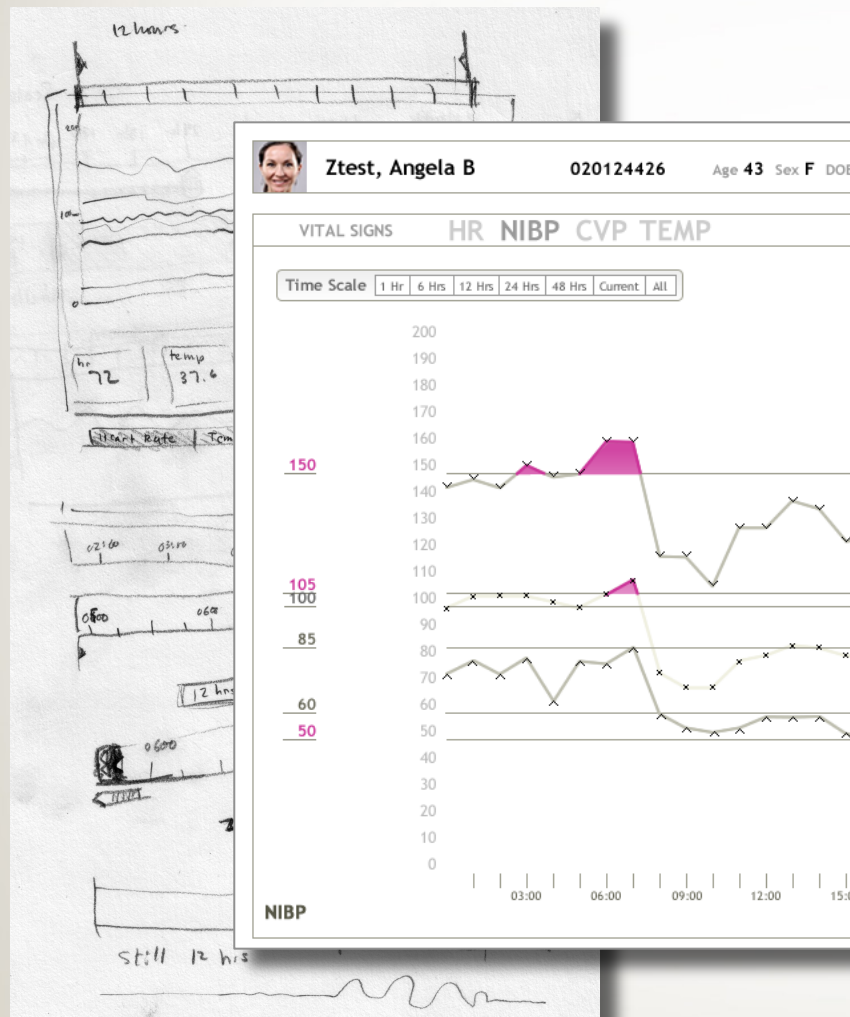
Save to file

Close Options Preview Save Send for Signature Send for Review Done!

After usability based redesign:

“This fits with how I would normally assess pressure ulcers. When will it be implemented?”

Iterative Design & Evaluation



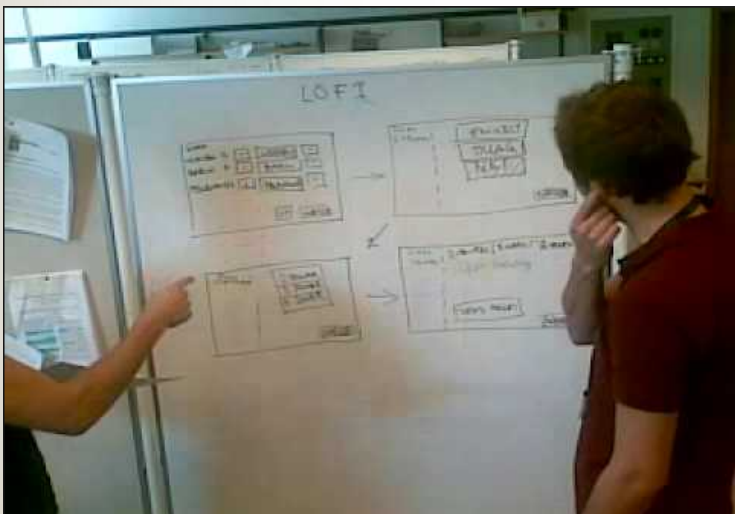
User-Centered Design: ISO 9241-210

**Evaluate
design against
requirements**

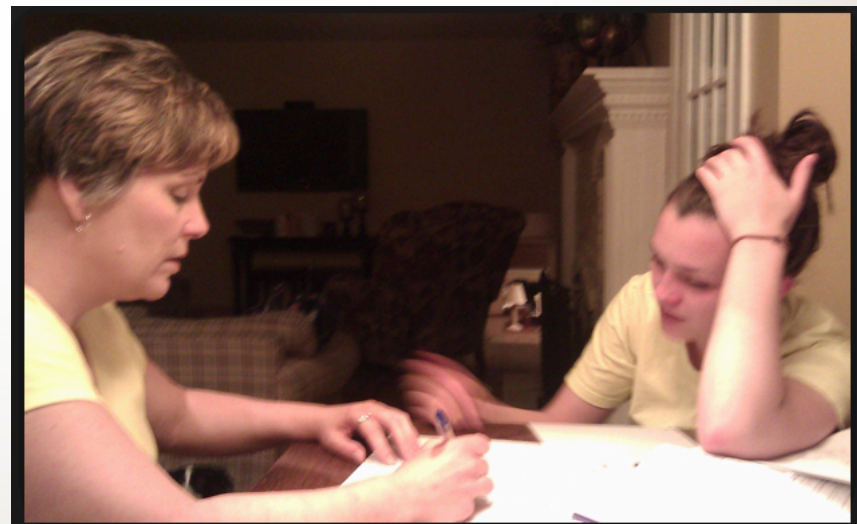
Early & often. Inspections - expert evaluations; Formative evaluations - involve real end-users carrying out tasks during design phase (paper mockups to fully developed prototype); Summative testing - Quantitative, verify that performance measures are met prior to roll-out or at beginning of project for legacy systems

Formative evaluations Provide systematic feedback about UI usability during design

Conceptual walkthroughs



Co-discovery sessions



Summative Usability Testing of a Blood Product Pre-administration Verification

- Institutional RFA yielded two vendor product finalists – The hospital asked us, “Should we purchase?” from a human factors perspective
- 22 clinician participants completed 3 realistic simulated scenarios.
- Clinicians identified all embedded errors but completion times were longer using technology than with current manual process and users were frustrated by having to repeat steps and with interaction issues.



Anders S, Miller A, Joseph P, Woods M, Booker R, Slaughter J, Weinger MB, & France D. (2011). Blood product positive patient identification: Comparative simulation-based usability test of two commercial products. *Transfusion*, 51, 2311-18.

User-Centered Design: ISO 9241-210

Solution meets
requirements

implementation, rollout & sustainability: Meeting needs of the present without compromising the future; UI Design supports evolution as user needs change

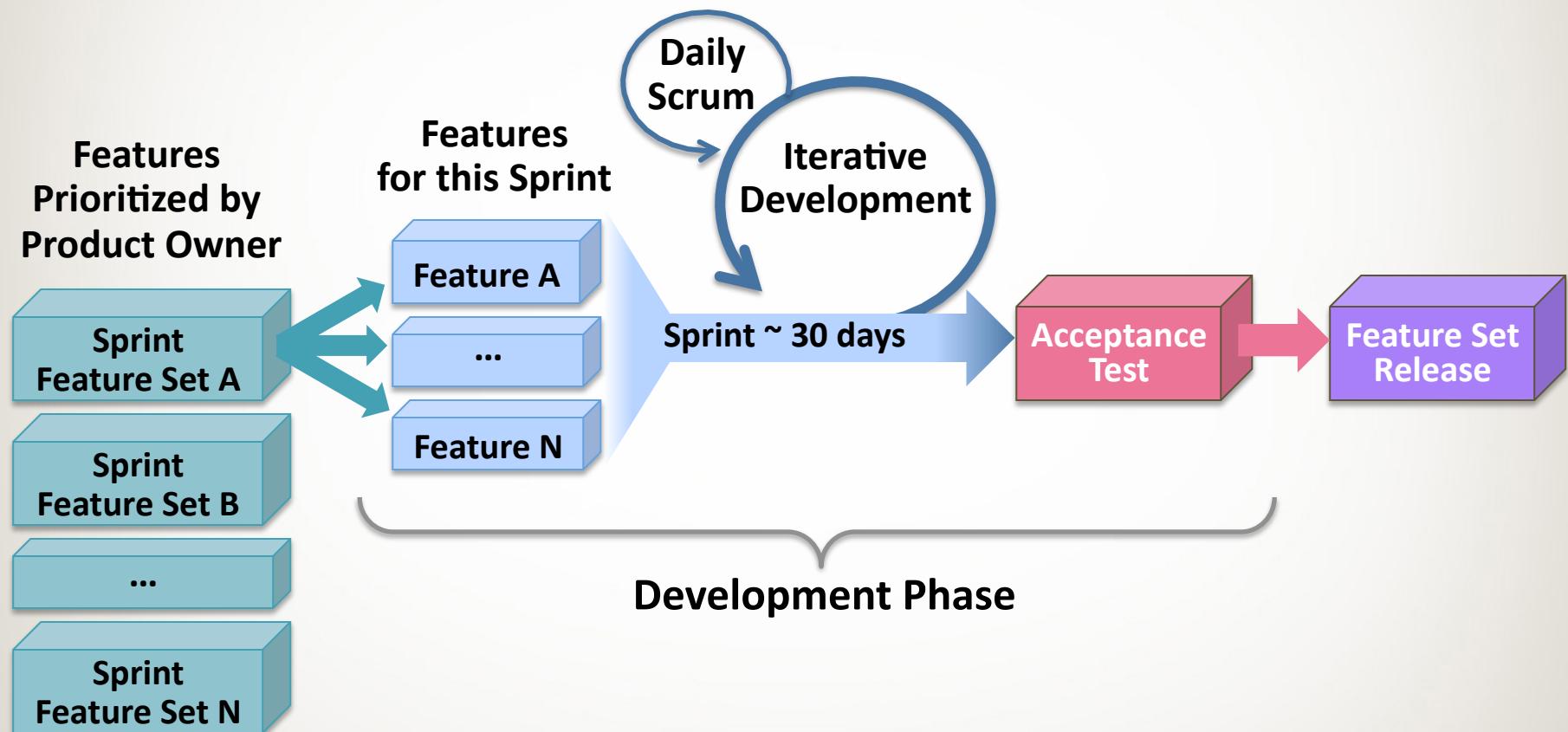
Did it work? What else did it enable?



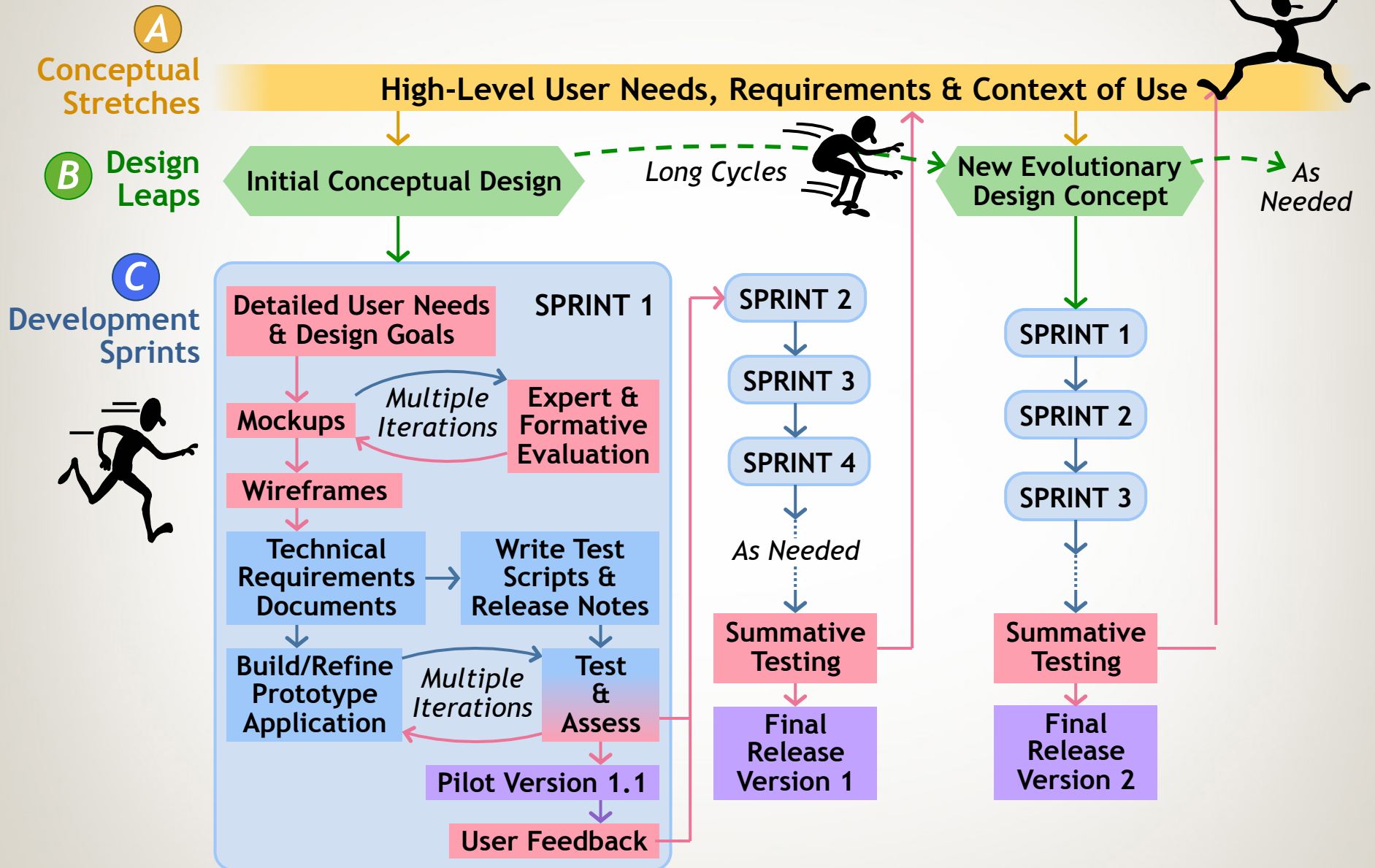
All usability flaws will never be revealed before product release

- **Formative and summative evaluations involve small numbers of selected sub-population(s) of users**
 - **In a controlled testing environment**
 - **Based on selected scenarios**
 - **Does not consider the full range of actual use contexts**
- **Insufficient use interactions to observe uncommon (rare) events**

Agile Process

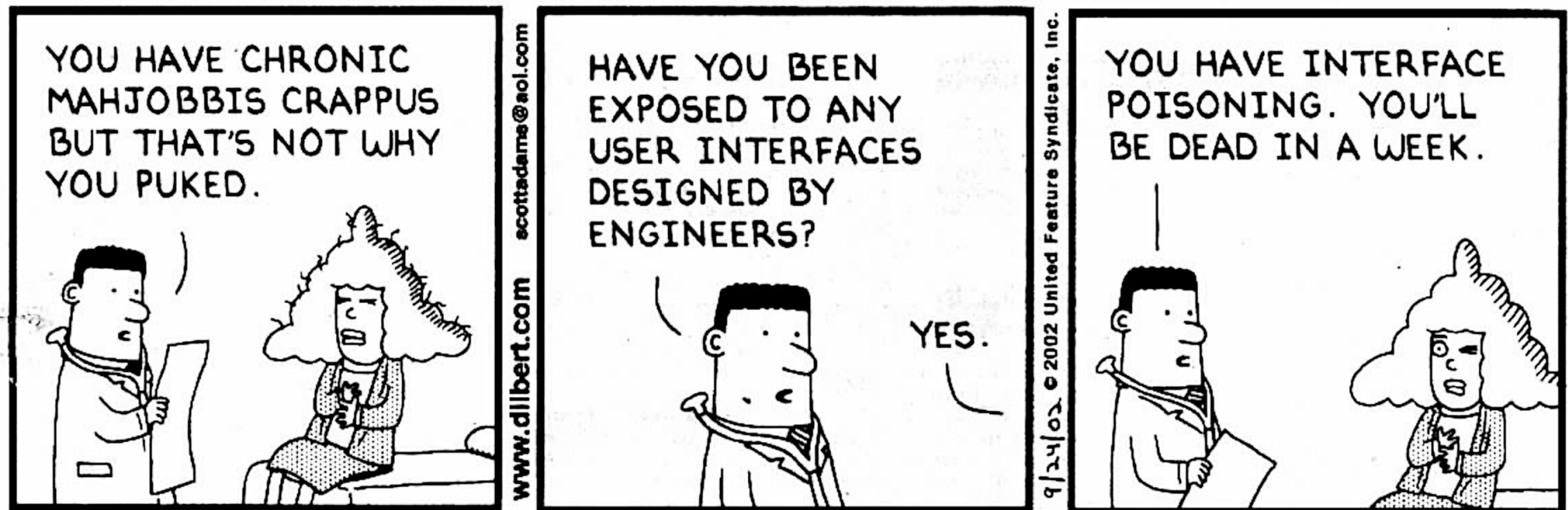


UCD in VUMC's Agile Environment



Bottom Line: *UI Design Matters!*

Dilbert by Scott Adams



Questions?



*Rapid pulse, sweating, shallow breathing ...
According to the computer, you've got gallstones.*