Categorization of Critical User Interactions for Pediatric EHR

— A TURF Model

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Outline

- What is TURF?
- A TURF Model for Critical User Interactions

What is TURF?

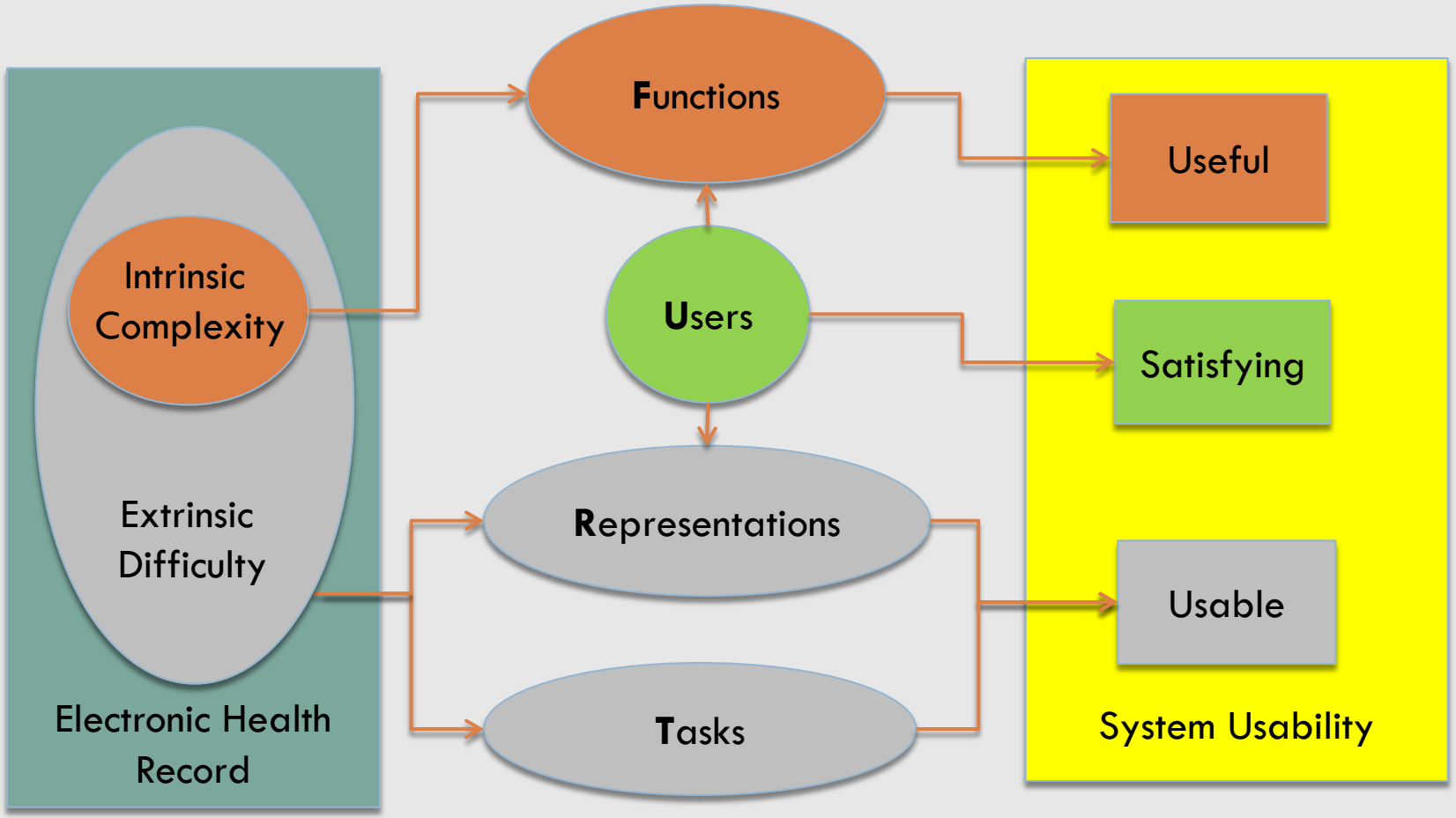
TURF - A Unified Framework of EHR Usability

- **An Acronym for**
  - **T**ask, **U**ser, **R**epresentation, & **F**unction
- **A Theory for**
  - defining, describing, explaining, and predicting usability
- **A Method for**
  - evaluating and measuring usability
  - designing usability
  - categorizing usability and safety problems
- **A Software Tool for**
  - (partially) automating usability evaluation
  - conducting user testing
  - building EHR ontology
  - generating evidence-based designs
  - conducting usability and patient safety analytics

What is Usability?

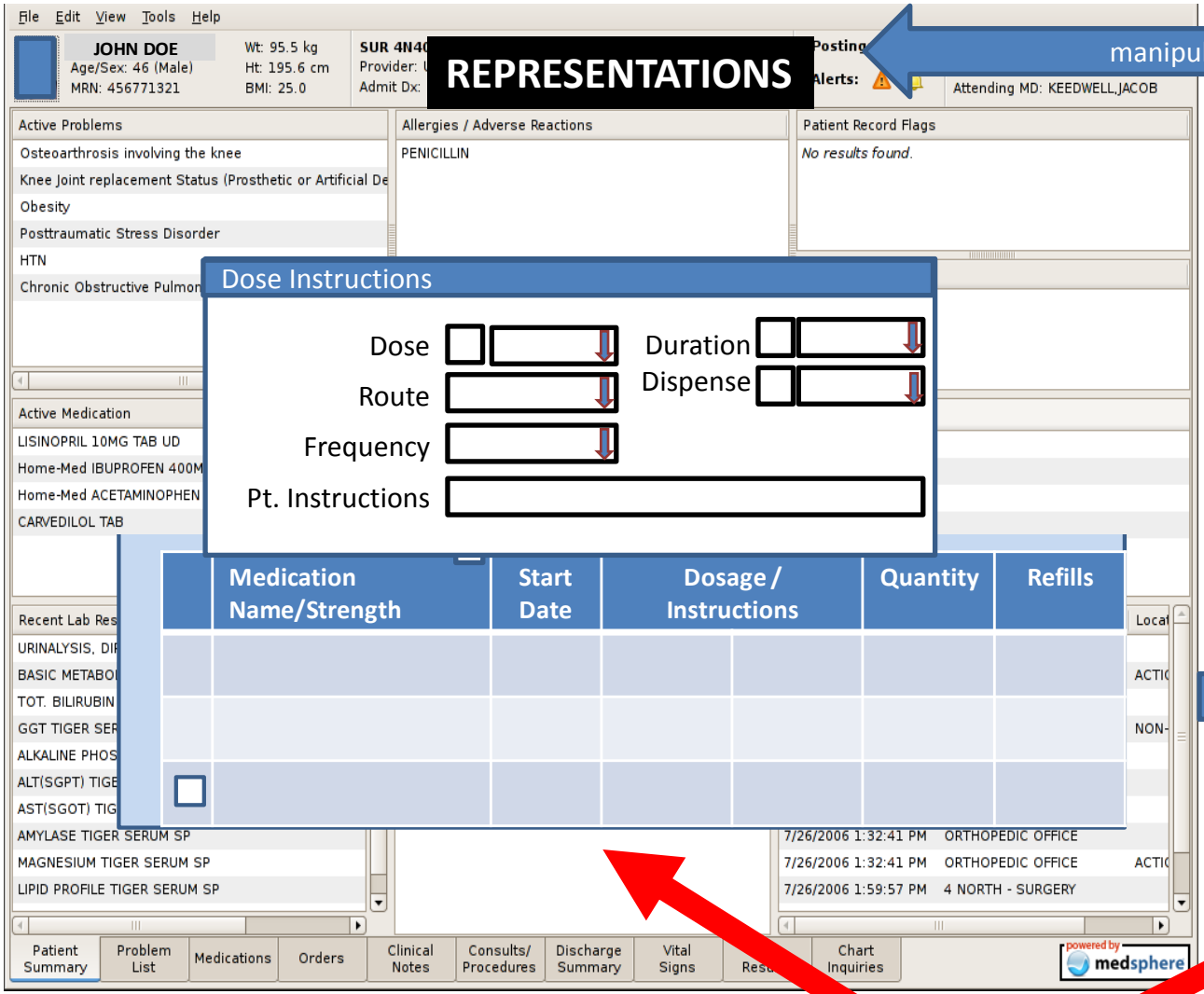
- Under TURF, usability is defined as how
  - useful,
    - usable,
      - satisfying
        - a system is for the intended users to accomplish goals in the work domain by performing certain sequences of tasks

TURF Framework for EHR Usability



Zhang, J., & Walji, M. (2011). TURF: Toward a unified framework of EHR usability. *Journal of Biomedical Informatics, 44 (6)*, 1056-1067.

Dr. Townshend prescribes 90 day supply of Metformin 500 mg tablets by mouth twice daily to patient John Doe who is a pre-diabetic patient with a glucose level of 110.



REPRESENTATIONS

manipulate

USERS

Dr. Townshend

execute

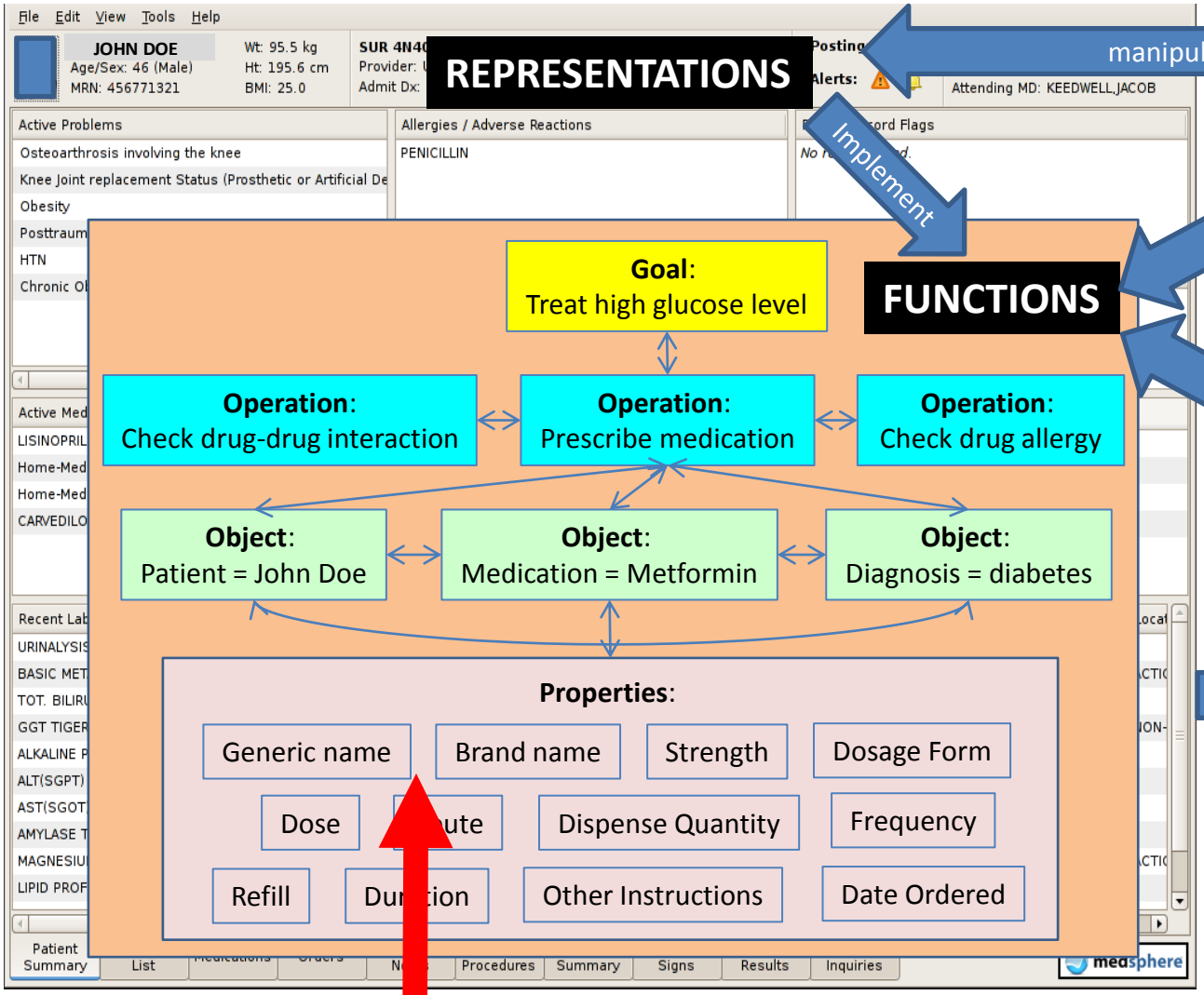
support

TASKS

Find the “Medication" tab
Point to “Medication" tab
Click “Medication" tab
Click “New Med” button
Wait for the system to show “Medication" window
Find the "Search all Meds"
Click "Search All Meds"
Wait for the system to show "Order a Med" pop-up window
Find “Search" field
Point to “Search" field
Type “Metformin"
Point to “Metformin" on the list
Click “Metformin" on the list
Wait for the system to show “Dose Instructions" window
Etc. etc. etc.

Extrinsic Difficulty--Usableness

Dr. Townshend prescribes 90 day supply of Metformin 500 mg tablets by mouth twice daily to patient John Doe who is a pre-diabetic patient with a glucose level of 110.



manipulate

Implement

accomplish

execute

realize

support

USERS

Dr. Townshend

FUNCTIONS

TASKS

Find the “Medication" tab
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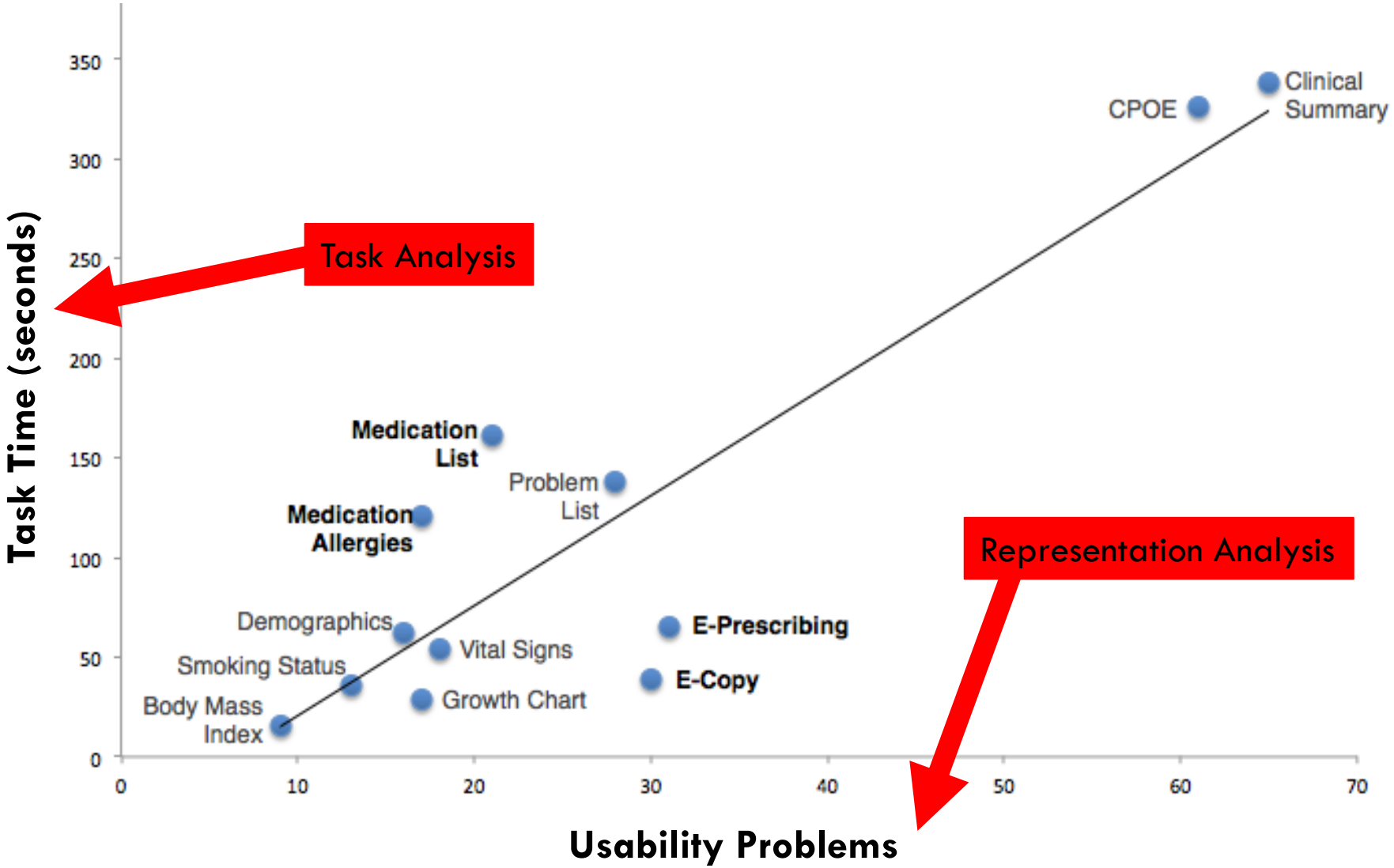
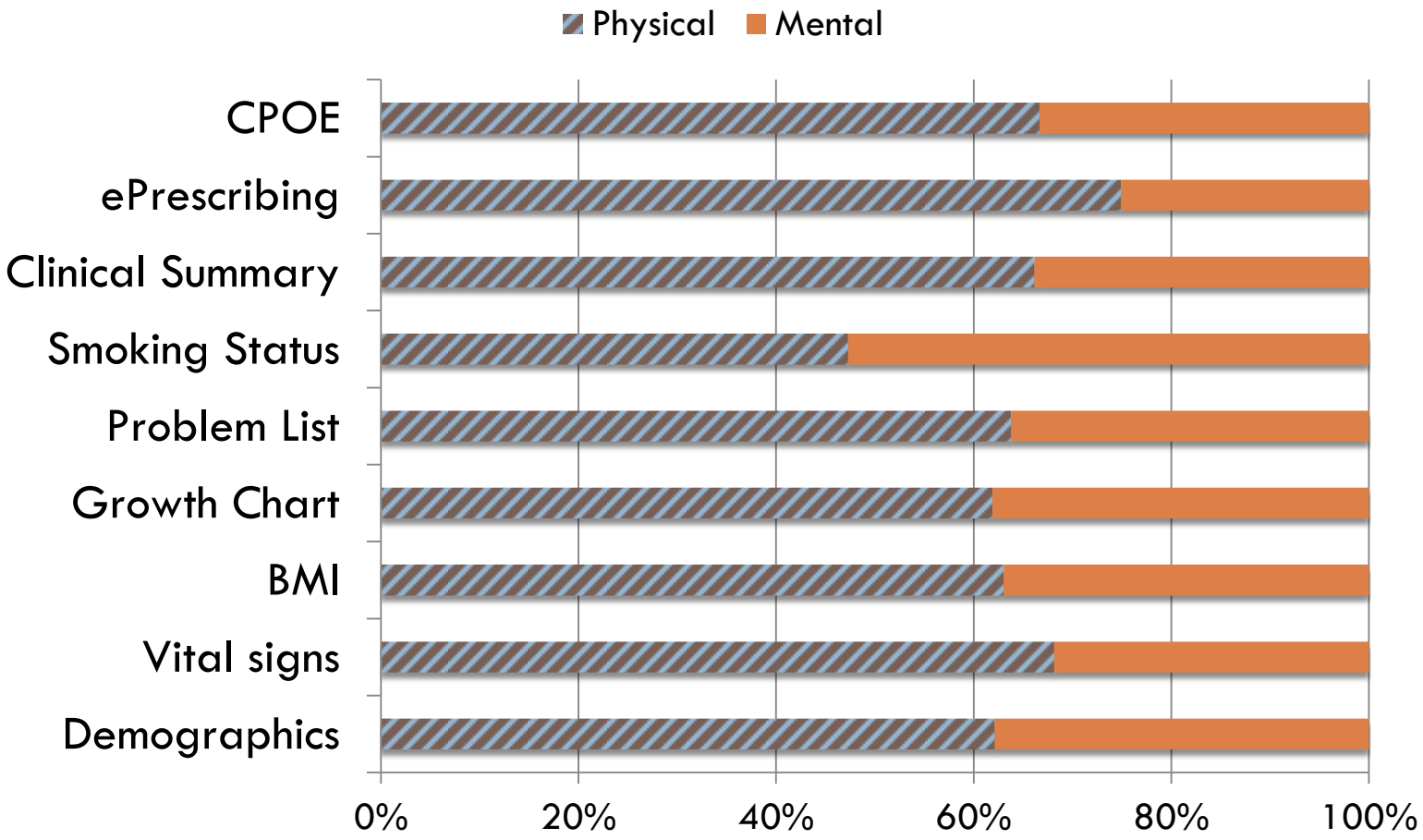
Intrinsic Complexity--Usefulness

Measuring Extrinsic Difficulty -- Usableness:

Task Time and Usability Problems

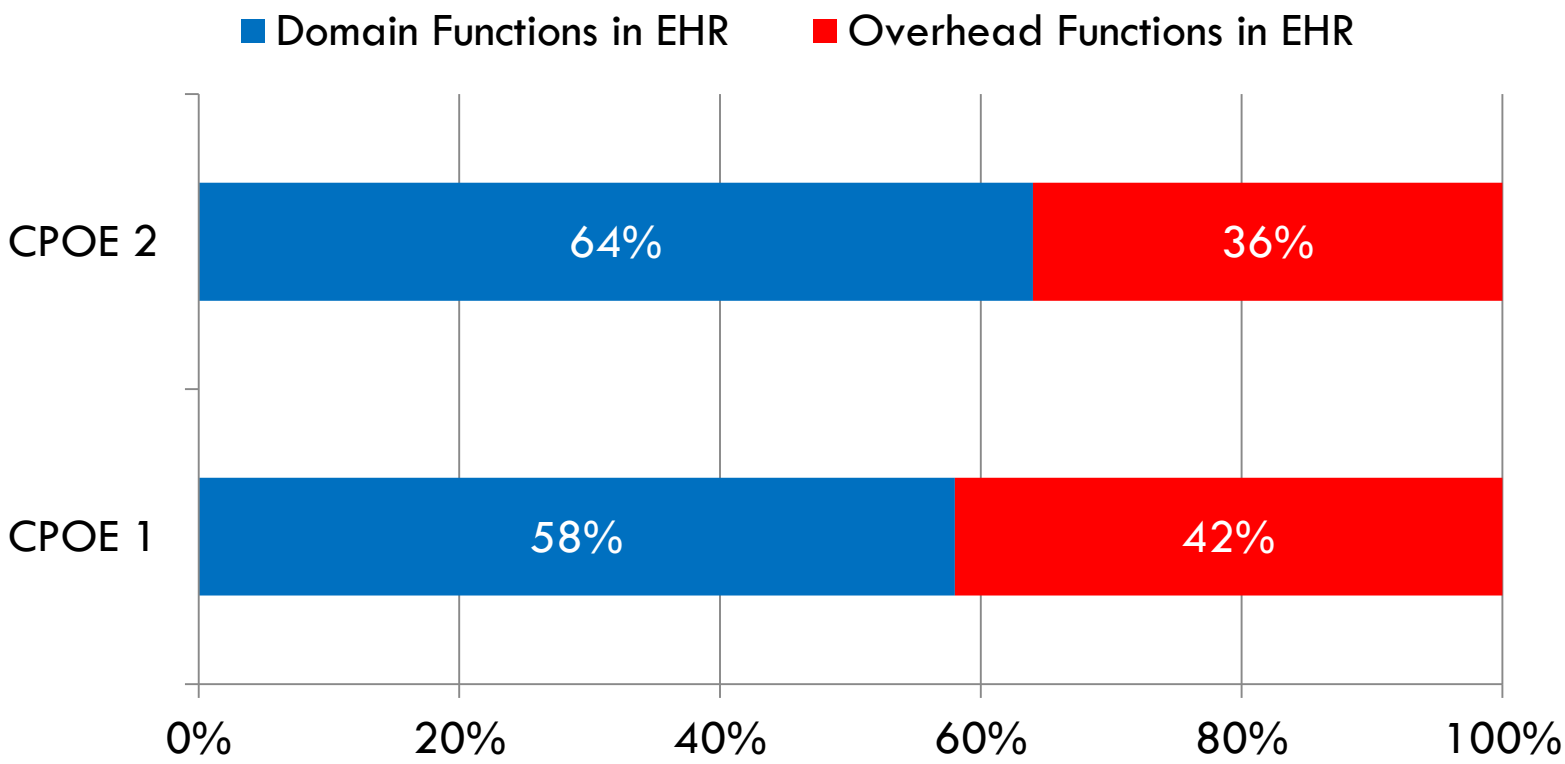


Measuring Extrinsic Difficulty -- Usableness: Mental Workload



Measuring Intrinsic Complexity-- Usefulness: Overhead Function

Overhead in EHR $=$ $\dfrac{\#\text{ Overhead Functions in EHR}}{\#\text{Domain Functions in EHR} + \#\text{Overhead Functions in EHR}}$



Measuring Intrinsic Complexity-- Usefulness:
Domain Function Completeness

$$\textbf{Domain Function Completeness} = \frac{\#\text{Domain Functions in EHR}}{\#\text{Domain Functions in Entire Work Domain}}$$

A Small EDR System

$$\frac{37}{80} = 46\%$$

(From Chen, 2008)

TURF Software Tool Architecture

Presentation layer

Data Collection | Modeling | Analysis & Report

Business layer

Data Capturing

Representation data:
Screenshot, video, widget
Interaction data:
Keystroke & mouse movement
User data:
Profiles and Personas
Function Data:
Work domain ontology

Mapping editor

Modeling

Data integration
Populate TURF models
Modeling engine
Repository management

Model-Driven Analysis

Usability Metrics
Usability Benchmarks
Usability & safety patterns
EHR domain ontology

Data Layer

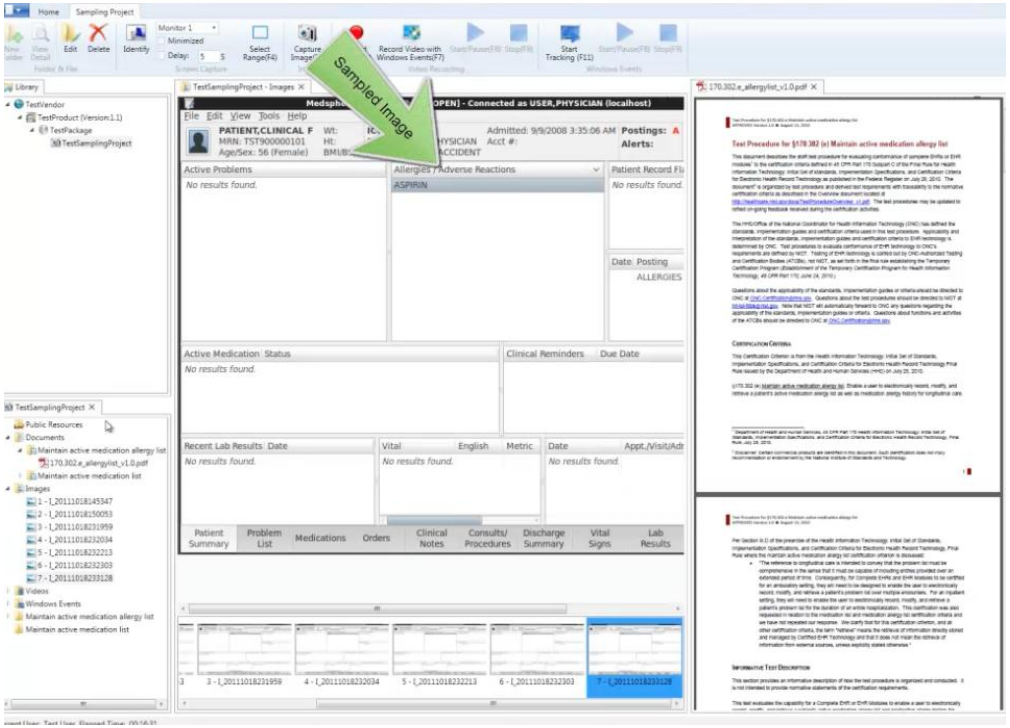
Data access components
Data utilities
Service agents

Entity-relational database
Ontology database

Other usability test/analysis services
(e.g., Cogtool, Ulog, Noldus, etc.)

TURF Software Tool:

Assess, measure, and improve EHR usability

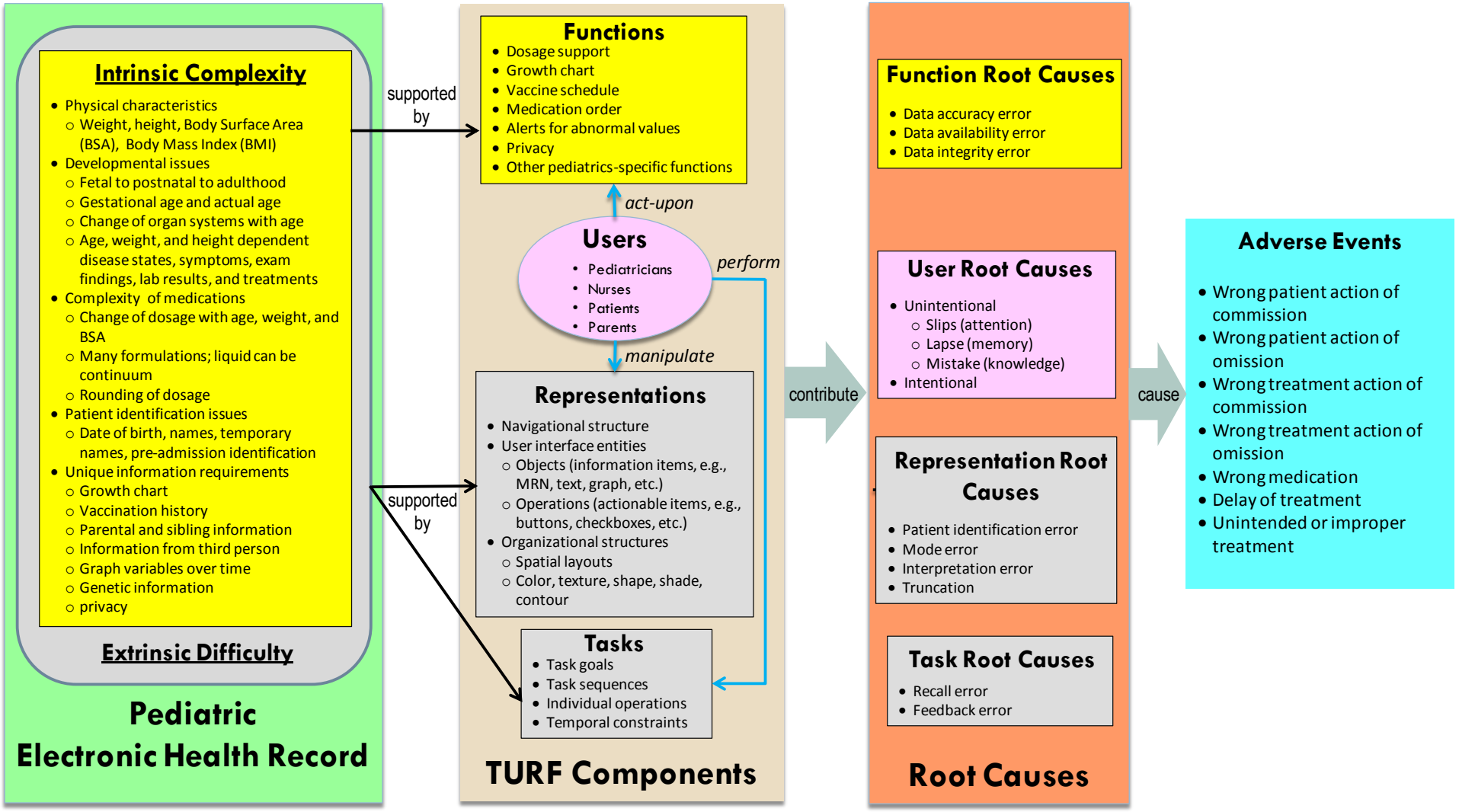


- Semi-automate usability expert reviews
- Build cognitive models to predict clinical task performance times
- Capture user testing data
- Build EHR ontology from usage data
- Generate evidence-based designs

TURF 1 Beta Release: Summer 2012

TURF Model for Critical Risks

A TURF Model of Critical Risks for Pediatric EHR

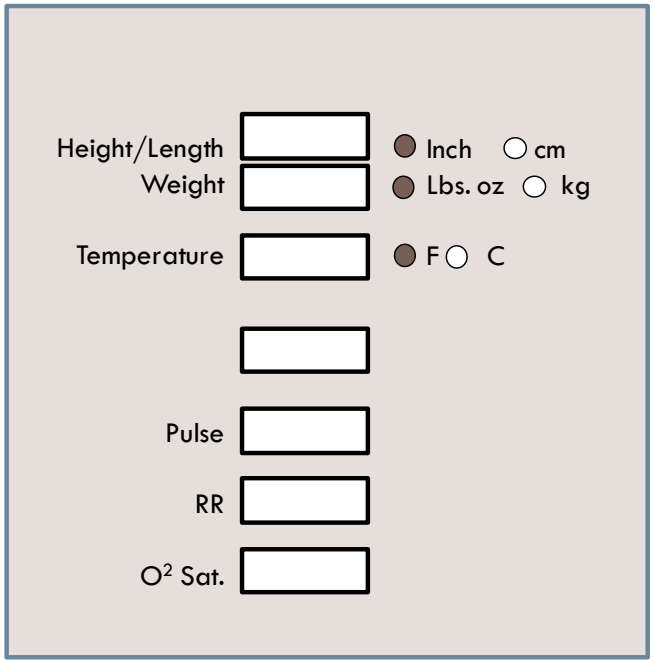


Function Root Causes

Description	Example	Potential Risk/Impact
Forced data format	Systolic blood pressure values must be entered as 3-digits (060)	Data entry errors

Function Root Causes

Description	Example	Potential Risk/Impact
Default Values	This pop-up reverts to prior data if a parameter is entered that is not "in range" with NO WARNING to the user.	Data entry errors



Representation Root Causes

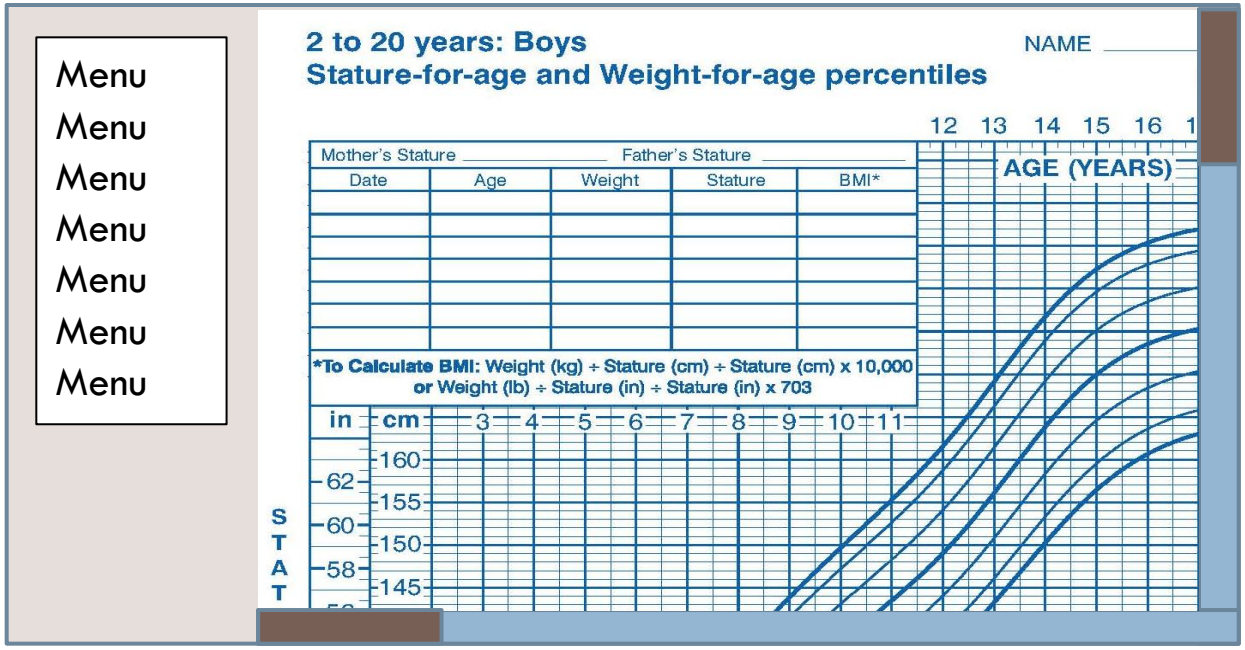
Description	Examples	Potential Risk/Impact
Mode error	A patient's weight and height are entered in pounds and inches, and then displayed in kilograms and meters.	Drug dosage miscalculation

Representation Root Causes

Description	Examples	Potential Risk/Impact
Patient identification error	Multiple patients' data are displayed concurrently. Diagnostic test is ordered for Patient A and thought to be Patient B	Wrong patient procedure

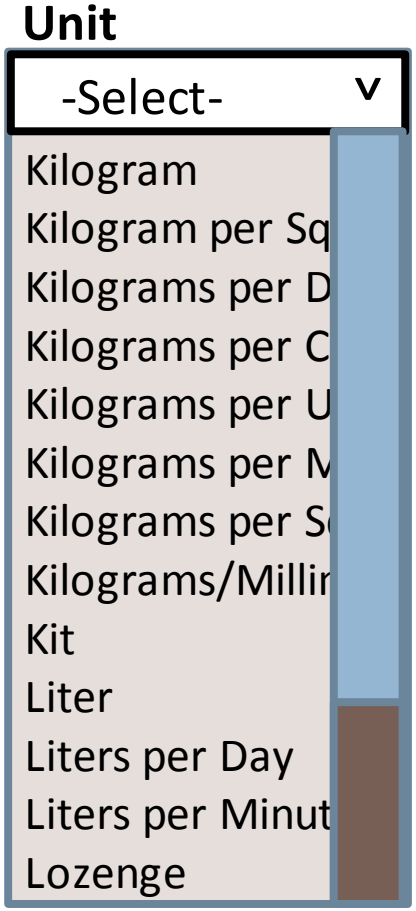
Representation Root Causes

Description	Example	Potential Risk/Impact
Visibility error	Does not allow entire growth chart in one view. No resizing. Requires 2 slider bars to **mentally** visualize the entire chart.	Missed diagnosis



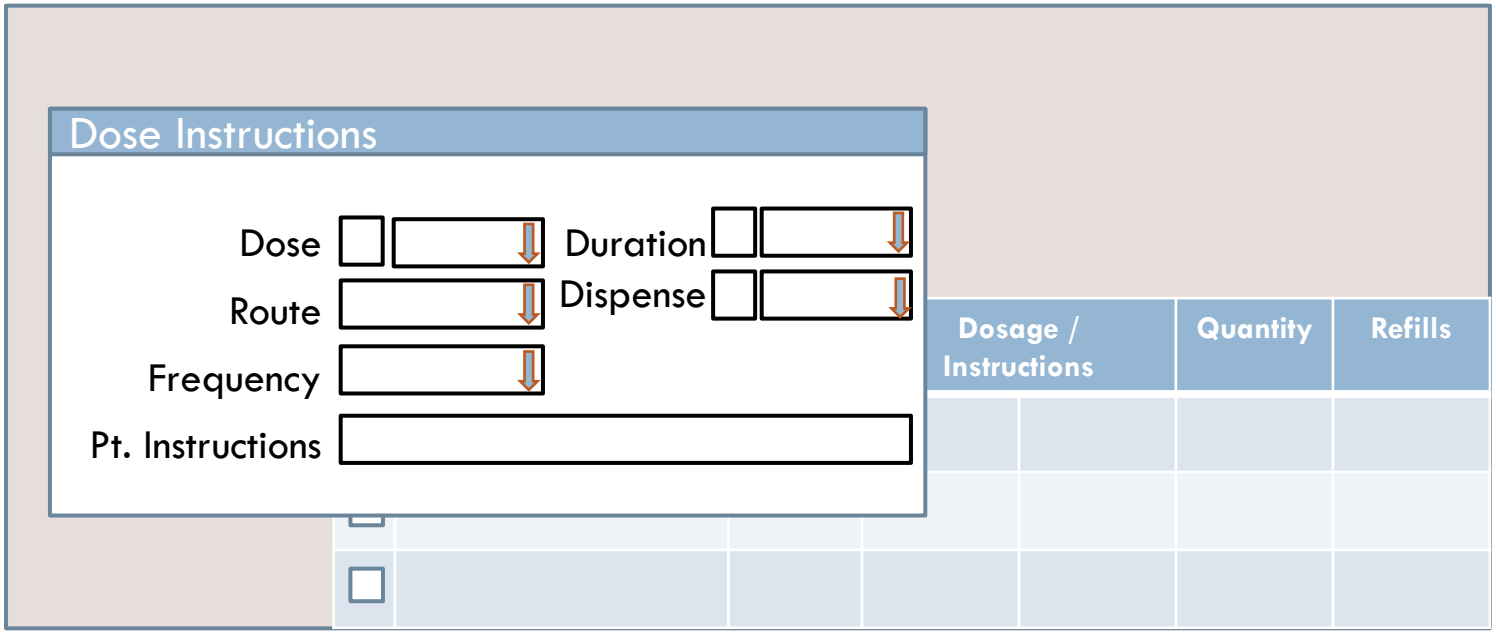
Representation Root Causes

Description	Example	Potential Risk/Impact
Truncation error	Drop down fields too narrow to allow the user to view the entire entry	Wrong dosage



Task Root Causes

Description	Example	Potential Risk/Impact
Sequence context error	No drug name or drug strength is listed in the pop-up. Need to memorize information across multiple windows.	Medication error



Conclusions

- Critical user interactions for EHR should be supported by work-centered design addressing root causes associated with users, functions (features), representations (user interface), and tasks (workflow)
- Pediatric EHR should be designed with special considerations of the uniqueness and complexity of pediatric care.

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Preliminary Program under Planning

Pre-AMIA Symposium

EHR Usability
for Stage 2 Meaningful Use

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Chicago

www.sharpc.org