



MedStar Health

It's how we **treat people.**

# Applying Safety Science to Healthcare

## Prioritize the Incidents & Focus on the Right Errors

CAHO Webinar

November 5, 2024

Kathryn (Kate) Kellogg, MD MPH

Vice President, Patient Safety & Infection Prevention, MedStar Health, Columbia, MD USA

Assistant Professor of Emergency Medicine, Georgetown University School of Medicine

# Agenda

- The State of Patient Safety
- Key Human Factors Engineering Concepts
- 3 Crucial Opportunities to Incorporate Human Factors into Patient Safety



# The State of Patient Safety



MedStar Health

Medicine used to be simple,  
ineffective, and relatively safe.

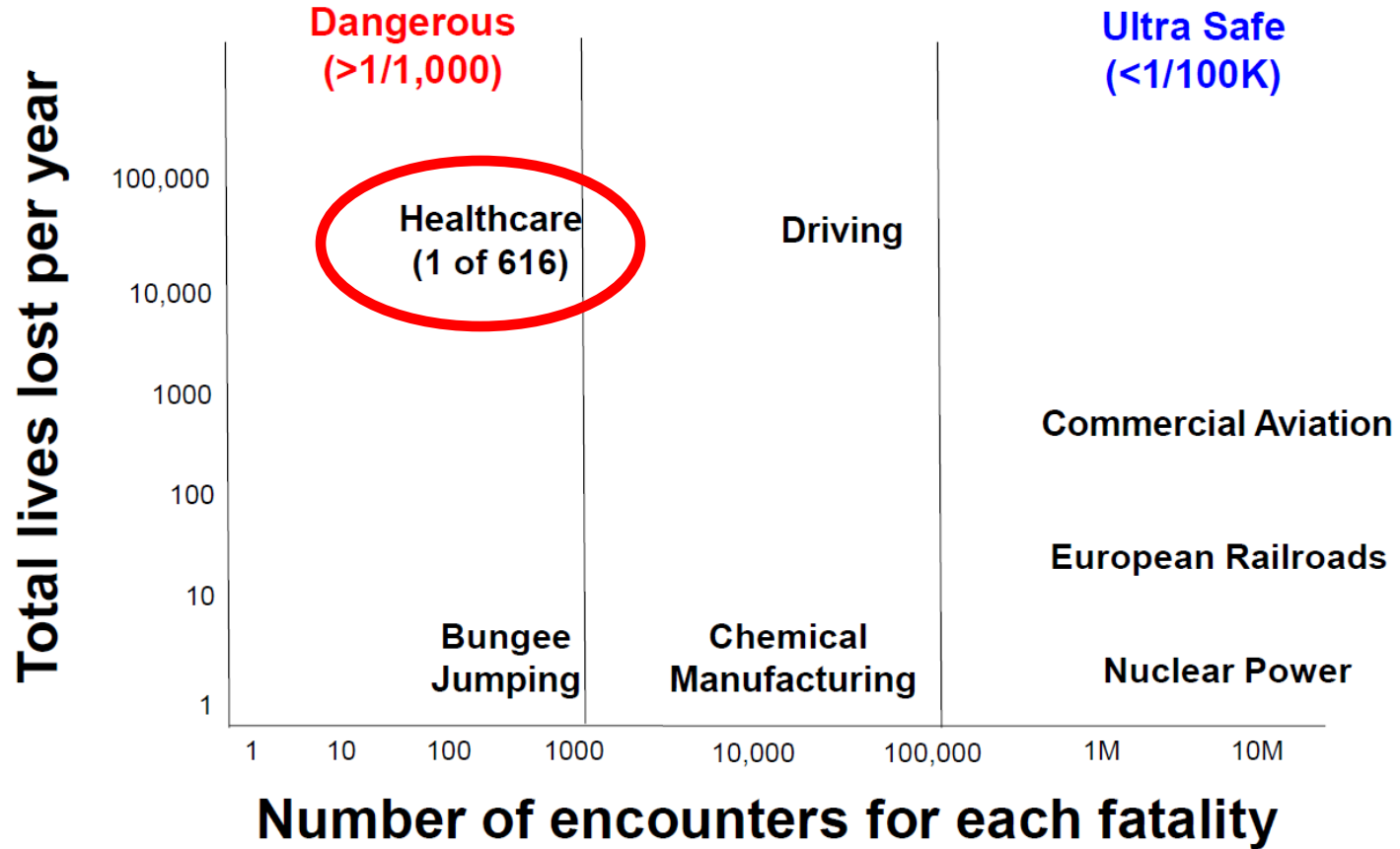
Now it is complex, effective,  
and potentially dangerous

*Sir Cyril Chantler*

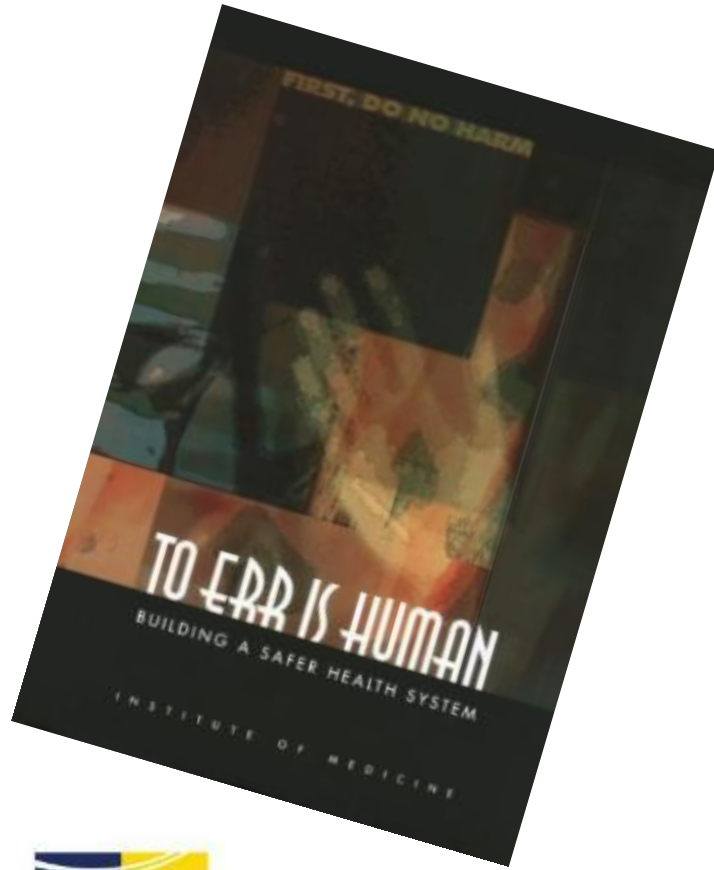


MedStar Health

Chart Credit: Modified from L. Leape







## What has happened since?

- Legislation & regulations
- Research funding
- New journals, associations, meetings
- Engagement with patients and families
- Patient safety organizations (PSOs)
- Education and Certification
- Public and media attention
- Attempts at Metrics

# Are we getting safer?

THE NEW ENGLAND JOURNAL of MEDICINE

## SPECIAL ARTICLE

### The Safety of Inpatient Health Care

David W. Bates, M.D., David M. Levine, M.D., M.P.H.,  
Hojjat Salmasian, M.D., Ph.D., M.P.H., Ania Syrowatka, Ph.D., David M. Shahian, M.D.,  
Stuart Lipsitz, Sc.D., Jonathan P. Zebrowski, M.D., M.H.Q.S.,  
Laura C. Myers, M.D., M.P.H., Merranda S. Logan, M.D., M.P.H.,  
Christopher G. Roy, M.D., M.P.H.,  
Lynn A. Volk, M.H.S., Sevan Du  
Heba H. Edrees, Pharm.D.,  
Jonathan S. Einbind  
and El

## Journal of Patient Safety and Risk Management

### Editorial

### Who killed patient safety?

Carole Hemmelgarn <sup>1</sup>, Martin Hatlie<sup>2</sup>, Susan Sheridan<sup>3</sup>, and Beth Daley Ullem<sup>4</sup>

# Not Fast Enough....

## JAMA Network™

JAMA | Original Investigation

### Trends in Adverse Event Rates in Hospitalized Patients, 2010-2019

Noel Eldridge, MS; Yun Wang, PhD; Mark Metersky, MD; Sheila Eckenrode, MA, RN; Jasie Mathew, MBA;  
Nancy Sonnenfeld, PhD; Jade Perdue-Puli, MPA; David Hunt, MD; P. Jeffrey Brady, MD, MPH; Paul McGann, MD;  
Erin Grace, MHA; David Rodrick, PhD; Elizabeth Drye, MD, SM; Harlan M. Krumholz, MD, SM

### Adverse Events in Hospitals: A Quarter of Medicare Patients Experienced Harm in October 2018

05-09-2022 | OEI-06-18-00400 | [Complete Report](#)

# Quality and Safety:

*Two distinct meanings which require different approaches, skills, training, competencies, and expertise*

## Quality: (quantitative)

- Degree of excellence measured against an established benchmark.

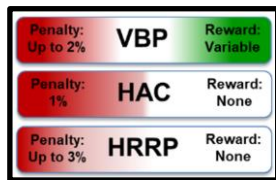
## Safety:

- Freedom from harm, danger, or risk.  
(qualitative)



*Institute of Medicine (IOM). Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, D.C: National Academy Press; 2001.*

## Quality Skills



## Data Analytics

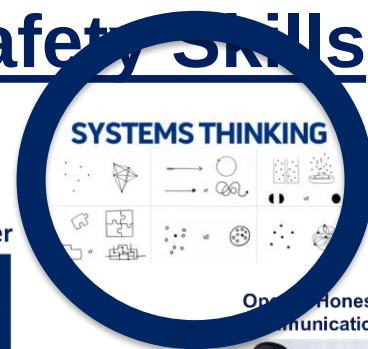
# Safety Skills



## Complex Systems

## Theory

## Care for the Caregiver



Open Honest



## Safety Culture



## Simulation



Human Factors and Ergonomics Society

## Psychological Safety



## Just Culture



## Cognitive Bias

## Teamwork Training



## Resilience Engineering



CPPS

CERTIFIED  
PROFESSIONAL IN  
PATIENT SAFETY

## Event Review



## Risk Assessment





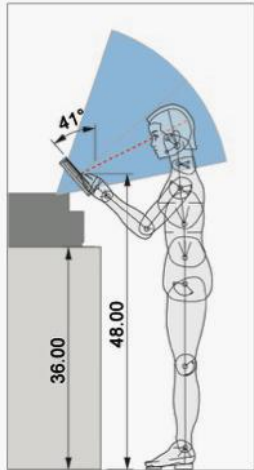
# Human Factors Engineering & Safety Science



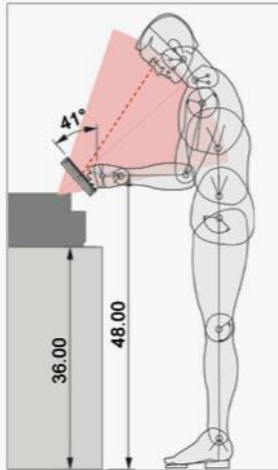
MedStar Health

# What is Human Factors?

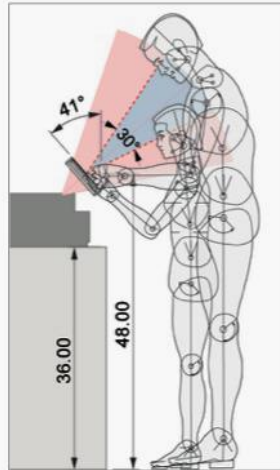
The understanding and application of information about human behavior, abilities, and other characteristics to the design of tools, machines, systems, tasks, jobs, and environments for productive, safe, comfortable, and effective human use.



5% female shown (China/Japan)



95% male shown (US/Europe)



both shown overlaid

**I am sans.**  
I am serif.

# Why Human Factors?

How many of you have...

- Pushed on a door when you should have pulled?



MedStar Health

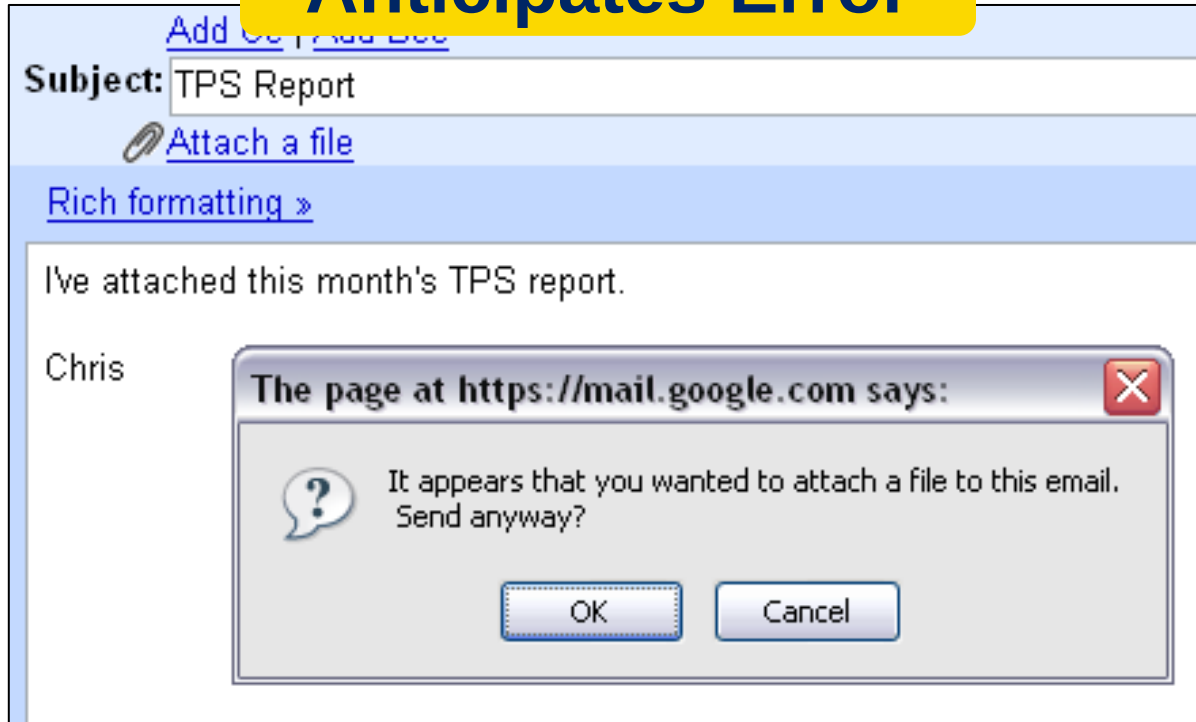
# How many of you have...

- Ever purchased the wrong grocery item because the labels looked similar?



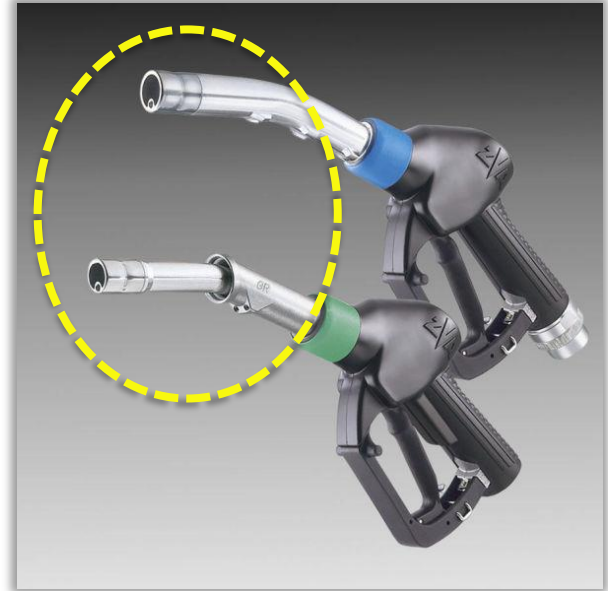
# Human Factors Influenced Design

## Anticipates Error



# Human Factors Influenced Design

Makes it hard to do the wrong thing



# Human Factors Influenced Design

**Makes it impossible to do the wrong thing**



# Human Factors Engineering

*We don't redesign humans.*

*We redesign the system within which humans work*



MedStar Health

Adaptation of Reason 2000

# Human Factors in Healthcare is all about:

Designing systems, processes, devices, software, and tools that:



Account for the complexity of the system



Fit human capabilities and limitations



Support the user through usable design



MedStar Health

# Human Factors in Healthcare is all about:

Designing systems, processes, devices, software, and tools that:



Account for the complexity of the system

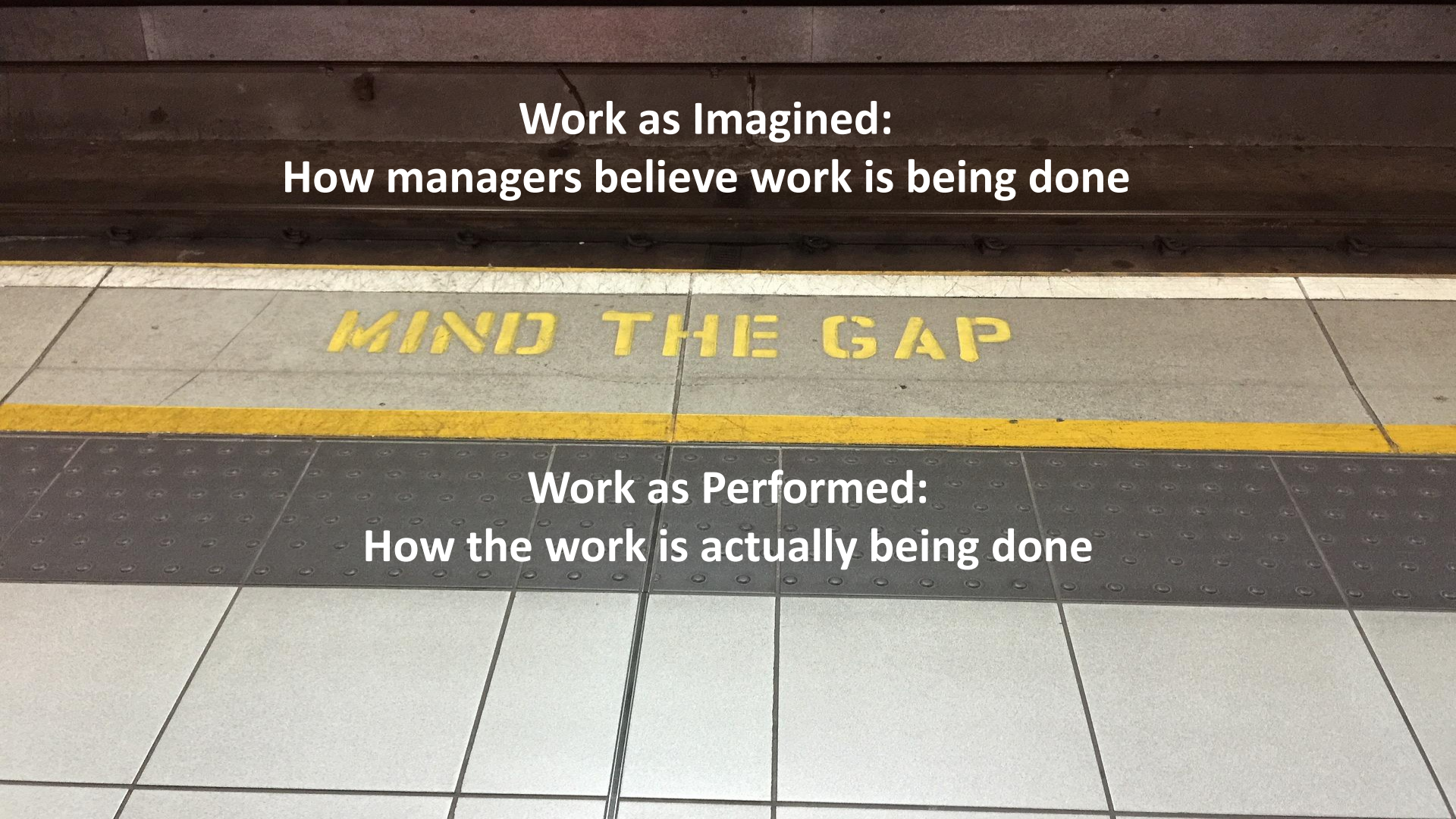


MedStar Health





MedStar Health

A photograph of a subway platform. At the top, there are dark, horizontal metal tracks. Below them, a concrete platform surface features a yellow line and the words "MIND THE GAP" painted in yellow capital letters. The bottom portion of the image shows a dark, textured metal grate with a grid of small circular holes, followed by a light-colored tiled floor with dark grout lines.

**Work as Imagined:**  
**How managers believe work is being done**

**Work as Performed:**  
**How the work is actually being done**

# Human Factors in Healthcare is all about:

Designing systems, processes, devices, software, and tools that:



Fit human capabilities and limitations



MedStar Health

# Principles of Human Performance

1. **Humans are fallible** and even the best make mistakes.
2. **Error-likely situations are predictable**, manageable, and preventable.
3. **Individual behavior is influenced** by organizational processes and values.
4. **Events can be avoided** by understanding the reasons mistakes occur.



**80% of flights involve  
one or more errors**

# Types of Error



Knowledge Based



Rule Based



Skills Based



MedStar Health

# Types of Error



Knowledge Based



Rule Based



Skills Based

Intended  
Actions

Unintended  
Actions



# Types of Errors



Knowledge Based



Rule Based



Skills Based



# Types of Errors



Knowledge Based



Rule Based



Skills Based



MedStar Health



80°F

# Types of Errors



Knowledge Based



Rule Based



Skills Based

Slips

Lapses



MedStar Health

# Skills Based Errors

## Slips



## Lapses



# Human Factors in Healthcare is all about:

Designing systems, processes, devices, software, and tools that:



Support the user through usable design



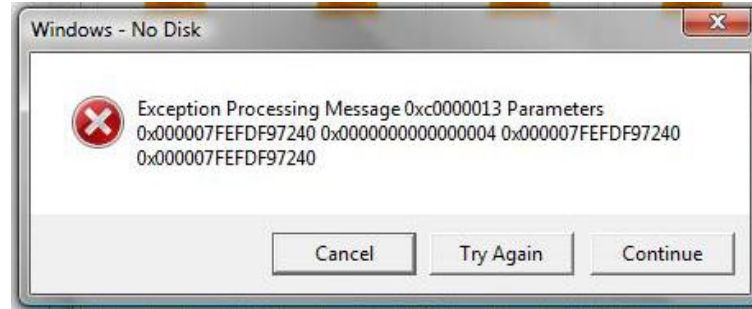
MedStar Health

# What does it mean to be usable?

Easy to do the right thing,  
hard to do the wrong thing



# Everyday Usability



2004



David M. Gaba, MD | October 1, 2004, web M&M  
<https://psnet.ahrq.gov/web-mm/thin-air>

2023



# Human Factors Influenced Design



# Usability in Healthcare

22 mmol/L

2.2 mmol/L

# Design with Usability in Mind

## Ibuprofen

(Examples are Motrin, Advil, and others)

### Dosing Chart

**10 mg/ kg dose**

| Weight in Pounds | Weight in kg | Total Dose (10mg/kg dose) | Infant Oral Drops (1 drop = 1.875mg) | Suspension (100mg/5mL) | Children's Tablets (100mg) | Junior Strength Tablets (100mg) | Adult Tablets (200mg) |
|------------------|--------------|---------------------------|--------------------------------------|------------------------|----------------------------|---------------------------------|-----------------------|
| 12 lbs           | 5.5          | 55 mg                     | 3 (51.25 mg)                         | 5.5 mL                 |                            |                                 |                       |
| 15 lbs           | 6.8          | 68 mg                     | 4 (75 mg)                            | 6.8 mL                 |                            |                                 |                       |
| 18 lbs           | 8.1          | 81 mg                     | 5 (93.75 mg)                         | 8.1 mL                 |                            |                                 |                       |
| 20 lbs           | 9            | 90 mg                     | 5 (93.75 mg)                         | 9 mL                   |                            |                                 |                       |
| 24 lbs           | 10.9         | 109 mg                    | 7 (131.25 mg)                        | 10.9 mL                |                            |                                 |                       |
| 28 lbs           | 12.7         | 127 mg                    | 8 (150 mg)                           | 12.7 mL                |                            |                                 |                       |
| 30 lbs           | 13.6         | 136 mg                    | 9 (168.75 mg)                        | 13.6 mL                |                            |                                 |                       |
| 34 lbs           | 15.5         | 155 mg                    | 10 (187.5 mg)                        | 15.5 mL                | 1 1/2 tablets              |                                 |                       |
| 38 lbs           | 17.3         | 173 mg                    | 11 (206.25 mg)                       | 17.3 mL                | 1 1/2 tablets              | 2 capsules                      |                       |
| 40 lbs           | 18.2         | 182 mg                    | 12 (215.625 mg)                      | 18.2 mL                | 2 tablets                  | 2 capsules                      |                       |
| 45 lbs           | 20.5         | 205 mg                    | 13 (240.625 mg)                      | 20.5 mL                | 2 tablets                  | 2 capsules                      |                       |
| 50 lbs           | 22.8         | 228 mg                    | 14 (262.5 mg)                        | 22.8 mL                | 2 1/2 tablets              | 2 capsules                      |                       |
| 55 lbs           | 25.0         | 250 mg                    | 15 (281.25 mg)                       | 25.0 mL                | 2 1/2 tablets              | 2 capsules                      |                       |
| 60 lbs           | 27.3         | 273 mg                    | 16 (300 mg)                          | 27.3 mL                | 3 tablets                  | 3 capsules                      |                       |
| 65 lbs           | 29.5         | 295 mg                    | 17 (318.75 mg)                       | 29.5 mL                | 3 tablets                  | 3 capsules                      |                       |
| 70 lbs           | 32           | 320 mg                    | 18 (345 mg)                          | 32 mL                  | 3 tablets                  | 3 capsules                      |                       |
| 75 lbs           | 34           | 340 mg                    | 19 (361.875 mg)                      | 34 mL                  | 3 1/2 tablets              | 3 capsules                      |                       |
| 80 lbs           | 36.5         | 365 mg                    | 20 (390.625 mg)                      | 36.5 mL                | 4 tablets                  | 4 capsules                      |                       |
| 85 lbs           | 38.5         | 385 mg                    | 21 (408.75 mg)                       | 38.5 mL                | 4 tablets                  | 4 capsules                      |                       |
| 90 lbs           | 41.0         | 410 mg                    | 22 (437.5 mg)                        | 41 mL                  | 4 tablets                  | 4 capsules                      | 2 capsules            |
| 95 lbs           | 43.1         | 431 mg                    | 23 (456.25 mg)                       | 43.1 mL                | 4 tablets                  | 4 capsules                      | 2 capsules            |
| Over 95          | Adult Dose   |                           |                                      |                        |                            |                                 |                       |

Date: 11/15/15

Your child's weight today is: 98.9g 5mL

Administer Ibuprofen as on the above chart every 6 to 8 hours for fever.  
FYI: 1 teaspoon = 5mL

**Note:** Do not administer Ibuprofen to any child under 6 months of age without first speaking with your Pediatrician.

## Ibuprofen Dosing Charts

(Brand names: Motrin, Advil, and others)

Date: \_\_\_\_\_

Child's Name: \_\_\_\_\_

Weight: \_\_\_\_\_ lbs \_\_\_\_\_ kg

**WHEN TO USE**

- For treatment of fever/pain for children ages 6 months and older.

**DIRECTIONS**

- Use your child's most recent weight to find dose on chart.
- If needed, repeat ibuprofen dose every 4-8 hours.
- Read all information on the product package before use.
- Refer to back side for more information about this dosing chart.

**WARNINGS**

- DO NOT give more than 4 doses in 24-hour period.
- DO NOT give ibuprofen to children under 6 months of age.

### Children's, Junior Strength or Regular Strength

| Weight (lb)     | Weight (kg)  | Children's Suspension (100mg/5mL) | Junior Strength (100mg) | Junior Strength (100mg) | Regular Strength (200mg) | Each Dose Based on 10mg/kg |
|-----------------|--------------|-----------------------------------|-------------------------|-------------------------|--------------------------|----------------------------|
| 13.2 - 17.0 lbs | 6 - 7.7 kg   | 3 mL                              |                         |                         |                          | = 60 mg                    |
| 17.6 - 21.0 lbs | 8 - 9.5 kg   | 4 mL                              |                         |                         |                          | = 80 mg                    |
| 22.0 - 26.0 lbs | 10 - 11.8 kg | 5 mL                              |                         |                         |                          | = 100 mg                   |
| 26.4 - 30.7 lbs | 12 - 13.9 kg | 6 mL                              |                         |                         |                          | = 120 mg                   |
| 30.8 - 35.3 lbs | 14 - 15.9 kg | 7 mL                              | 2 tabs                  |                         |                          | = 140 mg                   |
| 35.2 - 39.5 lbs | 16 - 17.9 kg | 8 mL                              | 3 tabs                  | 1.5 tabs                |                          | = 160 mg                   |
| 39.6 - 43.9 lbs | 18 - 19.9 kg | 9 mL                              | 3 tabs                  | 1.5 tabs                |                          | = 180 mg                   |
| 44.0 - 49.0 lbs | 20 - 22.4 kg | 10 mL                             | 4 tabs                  | 2 tabs                  | 1 tab                    | = 200 mg                   |
| 49.0 - 55.0 lbs | 22 - 24.9 kg | 12.5 mL                           | 5 tabs                  | 2.5 tabs                | 1 tab                    | = 250 mg                   |
| 55.0 - 60.0 lbs | 25 - 27.4 kg | 15 mL                             | 6 tabs                  | 3 tabs                  | 1 tab                    | = 300 mg                   |
| 60.0 - 67.0 lbs | 27 - 30.4 kg | 17.5 mL                           | 7 tabs                  | 3.5 tabs                | 1 tab                    | = 350 mg                   |
| 67.0 - 75.0 lbs | 30 - 34.0 kg | 20 mL                             | 8 tabs                  | 4 tabs                  | 2 tabs                   | = 400 mg                   |

Use table below for Ibuprofen infant drops or infant oral suspension (liquid).

### Infant Drops or Infant Oral Suspension (Liquid)

| Weight (lb)     | Weight (kg)    | Infant Suspension (Liquid) (50mg/1.25 mL) | Each Dose Based on 10mg/kg |
|-----------------|----------------|-------------------------------------------|----------------------------|
| 13.2 - 16.4 lbs | 6.0 - 7.4 kg   | 1.25 mL                                   | = 75 mg                    |
| 16.5 - 21.0 lbs | 7.5 - 9.5 kg   | 1.875 mL                                  | = 110 mg                   |
| 22.0 - 27.4 lbs | 10.0 - 12.4 kg | 2.5 mL                                    | = 150 mg                   |
| 27.5 - 32.0 lbs | 12.5 - 14.5 kg | 3.125 mL                                  | = 175 mg                   |
| 33.0 lbs        | 15.0 kg        | 3.75 mL                                   | = 230 mg                   |

Ibuprofen Dosing Charts

© 2014 MedStar Health



MedStar Health

# Human Factors in Healthcare is all about:

Designing systems, processes, devices, software, and tools that:



Account for the complexity of the system



Fit human capabilities and limitations



Support the user through usable design



MedStar Health

**NAME**

**BLAME**

**SHAME**

**TRAIN**



# Human Performance in Healthcare

“Incompetent people are, at most, 1% of the problem.

The other 99% are good people trying to do a good job, who make very simple mistakes and it's the processes that set them up to make these mistakes.”



Attributed to Dr. Lucian Leape  
Harvard School of Public Health

# Key Takeaways

- Humans are fallible
- The world around us strongly influences our performance

*“We don’t redesign humans;  
We redesign the system within which humans work”*



# **Integrating Human Factors & Safety Science Into Patient Safety**



MedStar Health

# Three Critical Opportunities for Safety Science

- After an event
  - Understanding the WHY
  - Developing strong solutions
- Before an event
  - Becoming proactive & designing safe systems

# MedStar Health's Innovative Event Review Process

- Learning focused process
- Based in Safety Science A
- Approach identifies true contributing factors and durable, effective solutions
- **Shapes the culture of the organization**



MedStar Health



**Get in the Tube**

# Finding the “Actual Whys”: Identifying Contributing Factors



**Communication  
&  
Information  
Management**



**Human Factors  
&  
Influences**



**Policy  
&  
Procedures**



**Human  
Resources  
&  
Training  
&  
Competency**



**Leadership  
&  
Culture Issues**



**Physical  
Environment  
&  
Equipment**



---

## Strong Actions

Architectural/physical plant changes

New devices with usability testing

Engineering control (forcing function)

Simplify process

Standardize equipment or process

Tangible involvement by leadership

---



---

## Intermediate Actions

Redundancy

Software enhancements, modifications

Eliminate/reduce distractions

Simulation-based education, with periodic refresher sessions/observations

Checklist/cognitive aids

Eliminate look and sound-alikes

Standardized communication tools

Enhanced documentation/communication

---



---

## Weaker Actions

Double checks

Warnings

New procedure/memorandum policy

Training

---

# What Does Proactive Safety Look Like?



## New Procedure Checklist for MedStar Health Ambulatory Sites

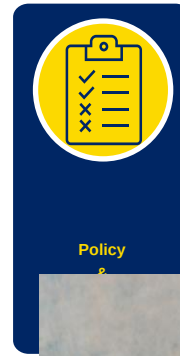
Submit form or questions to [AmbulatoryGS@medstar.net](mailto:AmbulatoryGS@medstar.net)

|                                                                                                                                                                                                                                                                                                                                 |                                                               |                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------|
| Submitted By:                                                                                                                                                                                                                                                                                                                   |                                                               |                             |
| Date:                                                                                                                                                                                                                                                                                                                           |                                                               |                             |
| Procedure Name:                                                                                                                                                                                                                                                                                                                 |                                                               |                             |
| Procedure Description:<br><i>Please give sufficient technical detail to facilitate understanding by those not familiar, including sterile technique, instruments:</i>                                                                                                                                                           |                                                               |                             |
| Is this procedure already performed at MedStar Health?                                                                                                                                                                                                                                                                          | <input type="checkbox"/> Yes                                  | <input type="checkbox"/> No |
|                                                                                                                                                                                                                                                                                                                                 | If yes, please list the primary locations and proceduralists: |                             |
| Planned location for procedure:                                                                                                                                                                                                                                                                                                 |                                                               |                             |
| Is this a new location for providers? If yes, do you need<br><ul style="list-style-type: none"><li>• A new office phone number?</li><li>• A new scheduling location in IDX or MedConnect?</li><li>• To modify or add a new location in the Patient Safety Event Management System (RL Solutions) for event reporting?</li></ul> | <input type="checkbox"/> Yes                                  | <input type="checkbox"/> No |
| Desired start date:                                                                                                                                                                                                                                                                                                             |                                                               |                             |
| Anticipated Number of Procedures Per Day/Week:                                                                                                                                                                                                                                                                                  | #/Day:                                                        | #/Week:                     |

2 | Page



# Thinking Differently Tomorrow



MedStar Health

# Thank you.

Kate Kellogg, MD MPH  
Vice President, Patient Safety & Infection  
Prevention, MedStar Health  
Assistant Professor, Georgetown  
University School of Medicine

[kate.m.kellogg@medstar.net](mailto:kate.m.kellogg@medstar.net)  
@katekelloggMD

**It's how we **treat people.****



MedStar Health