HUMAN FACTORS IN HEALTHCARE

A Systems-Based Approach to Improve Safety, Efficiency and Quality

MedStar Health
National Center for
Human Factors in Healthcare

Human factors is about using a deliberate scientific approach to designing the system within which humans work, not redesigning humans.

***Raj Ratwani,** MA, PhD, Director,*
MedStar Health National Center for Human Factors in Healthcare

What is **Human Factors?**

A multi-disciplinary science that sits at the intersection of psychology and engineering

Focused on understanding the interaction among humans and other elements of a system within a given environment

Applies psychological and physiological principles and theories to the design of products, processes and systems

Improves safety, efficiency, quality and reliability when applied effectively, while also reducing costs

Human factors is used across a number of high-risk fields including automotive, aviation, defense and healthcare.




The Role of Human Factors **in Healthcare**

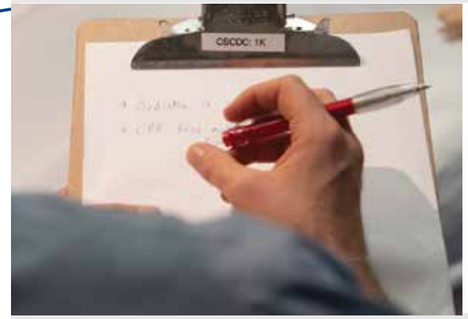
Applying human factors to healthcare reduces medical errors and allows clinicians to deliver better care to their patients. In practice, human factors **boosts work processes, enhances patient safety, reduces inefficiencies and improves quality.**

We conduct rigorous research and apply scientifically grounded principles to study and improve the interrelationship between providers, the equipment and processes they use and the environment in which they work with the patient as a central focus.

This helps to:

- Improve patient safety and satisfaction
- Reduce clinician burnout
- Boost process efficiency
- Enhance communication
- Generate effective and sustainable solutions
- Mitigate the risk of error
- Optimize training
- Design user-centered health IT solutions

Make it easy to do the right thing and hard to do the wrong thing.



MEDICAL ERRORS
CONTRIBUTE TO AN ESTIMATED
100,000 TO 200,000
DEATHS PER YEAR
Source: Institute of Medicine

Who We Are

Founded in 2010, the **MedStar Health National Center for Human Factors in Healthcare** (the Center) is an applied research, usability, safety advisement and education center committed to the scientific study of how humans think, work and interact within the healthcare environment.

Located in Washington, D.C. as part of the MedStar Institute for Innovation, and in collaboration with the MedStar Health Research Institute and the MedStar Institute for Quality and Safety, the Center is the largest human factors program embedded within a healthcare system.

MedStar Institute for Innovation

MedStar Health National Center for Human Factors in Healthcare

MedStar Health *Institute for Quality and Safety*

MedStar Health Research Institute

VISION

Advance health through significant contributions in research application and the diffusion of knowledge in healthcare human factors

MISSION

Improve the safety, efficiency and quality of healthcare through innovative application of the science of human factors and system safety

APPROACH

Embrace a systems perspective, recognizing the complex interactions between people, technology and the environment

As part of the MedStar Health system, the Center's unique, patient-first philosophy provides:

Access

Direct access to 10 hospitals and more than 280 diversified healthcare organizations in MedStar Health's clinical environments, as well as frontline clinicians and patients in a wide array of clinical settings

Expertise

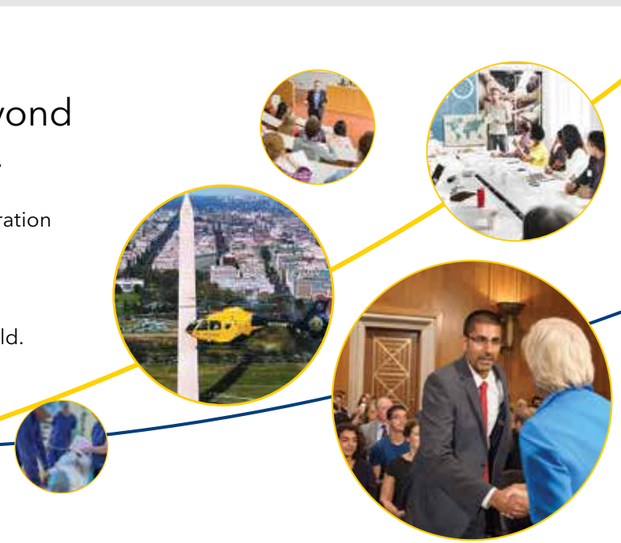
Multi-disciplinary expertise including human factors engineers, clinicians, computer scientists, informatics experts and environmental designers, as well as faculty partners that prioritize user needs

Scientific Rigor

Nationally-recognized academic excellence that is operationally focused—MedStar Health is a leading medical institution and home to one of the largest graduate medical education programs, ground-breaking new technology and a unique environment to spur innovation

Our work extends far beyond one single health system.

With a focus on increasing knowledge generation and transfer, seeking innovative strategies and providing valuable insights to help inform change, we work with more than 100 organizations in the U.S. and around the world.



> *By understanding the underlying causes of near misses or errors, we can keep patient safety at the forefront of everything we do. MedStar Health's National Center for Human Factors in Healthcare looks at the system humans work within, identifies areas for potential error and redesigns the system to mitigate those risks.*
>
> ***Stephen R.T. Evans**, MD, Chief Medical Officer, MedStar Health*

What We Do

The Center provides the following core services to improve healthcare safety, efficiency and quality.

Research
Leverages theory to conduct applied research that addresses critical safety problems and contributes to the generation and dissemination of knowledge in the healthcare industry

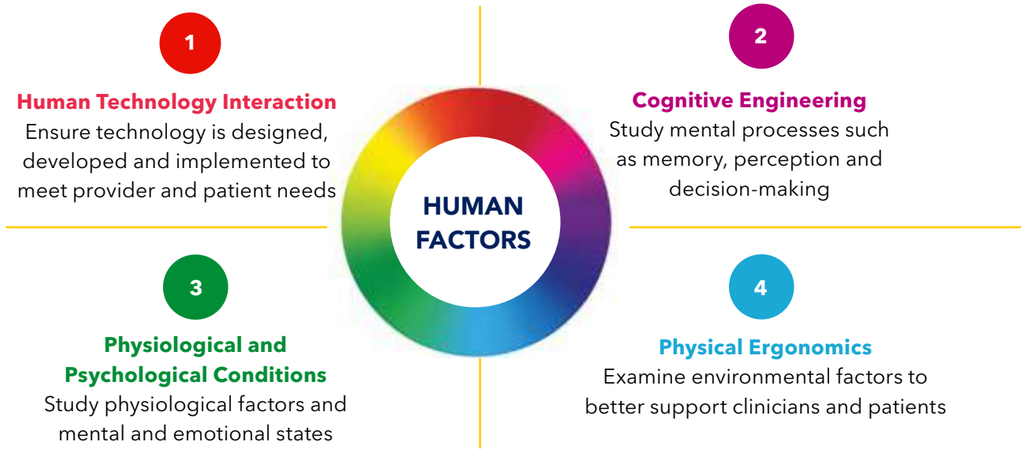
Usability Services
Contributes to the development of products and processes that are user-centered through understanding human capabilities and limitations

Safety Advisement
Provides a systems approach that assesses multiple factors and promotes a proactive path to safety

Education and Outreach
Offers dedicated training and mentoring to the next generation of human factors specialists, domestically and globally

OUR APPROACH

Our systems-based approach is defined through four areas of expertise across the human factors spectrum.



METHODOLOGY

We have expertise rigorously applying a variety of methods:

General
Answers specific questions about human behavior in complex environments

- Focus groups and interviews
- Time motion studies
- Ethnography/ Observations
- Eye tracking
- Physiological sensors
- Data mining

Modeling
Uses quantitative techniques to understand human behavior and interactions with their environment

- Machine learning and statistical models
- Natural language processing
- Mental models
- Predictive analytics

Usability
Identifies user needs, designs and develops for these needs, and assesses to ensure they are met

- Heuristic analysis
- Task analysis
- User-centered design
- Usability testing (Summative/ Formative)

Safety and Risk Assessment
Identifies safety hazards and assesses risk

- Failure mode effects analysis
- Human error identification
- Incident investigation
- Space syntax

Research

The Center is internationally recognized for its high impact applied research. We take a collaborative approach to research and have worked with federal agencies, medical associations, foundations, universities and industry partners.

Federal Agencies | Medical Associations | Foundations | Universities | Industry

Our Expertise in Action

The Center has published **more than 100 peer-reviewed journal publications** in top tier journals such as JAMA, JAMA Pediatrics and Health Affairs.

Research Excellence and R01 Awards

Research Project Grant (R01) awards from the U.S. Department of Health and Human Services are among the most prestigious grant mechanisms. **Our Center** has led **4 R01 awards** resulting in high impact research that is advancing clinical practice.

SPOTLIGHT STORY

Sepsis develops in approximately one of every 23 hospital admissions and accounts for nearly half of all hospital deaths. However, awareness of sepsis is low and many septic patients are not diagnosed at an early stage when aggressive treatment has the potential to reverse the course of infection. Currently, clinicians must rely on clues to sepsis progression by "hunting and gathering" in the electronic health record (EHR), searching a patient's medical history, vital signs and clinical lab values.

1 in 3

Patients who die in a hospital have sepsis

Source: CDC

In 2017, the U.S. National Library of Medicine through the U.S. National Institutes of Health awarded the Center a $1.4 million R01 grant to better understand how clinicians interpret and respond to clinical decision support for sepsis. The study examines various ways to display information to effectively alert healthcare providers to possible danger and guide them through evidence-based best practices to turn the infection around before it becomes deadly. Results from this research have the potential to improve the EHR system and significantly impact the design of clinical care and practice, both for sepsis and more generally.

Usability Services

The Center provides customized usability consultations across the product lifecycle—from initial concept to design to implementation—to meet users' critical needs as digital health and innovative technology rapidly advance.

Our experts test the safety and effectiveness of products, providing valuable insight to ensure they are market-ready. Because of our unique setting within MedStar Health, the Center has unparalleled access to conduct usability tests in an actual clinical environment.

In addition, MedStar Health's extensive simulation centers provide a variety of test settings including high fidelity patient-based healthcare simulators, "serious game-based" simulations and others.

We have experience with:

- Medical devices and combination products in all healthcare domains
- Medical device accessories
- Websites and mobile applications
- Health IT (electronic health records, telehealth, etc.)
- Home-use products
- Training programs
- Instructions for use
- Signage and training

At the Center, more than

90% **of our usability services are for external clients in the digital health industry.**

PRODUCT PHASE	USABILITY TOOL EXAMPLES
1 Conceptualization	Ethnography Focus Groups and Interviews Legacy Systems Evaluations
2 Analysis	Use Cases and User Profiles Task Analysis Failure Modes and Effects Analysis
3 Iterative Design	Heuristic Evaluation Formative User Testing Instruction and Labeling Assessment
4 Validation	Summative User Testing Root Cause Analysis Evaluation of Residual Risk
5 Procurement	Environmental Analysis Comparative Usability Testing Risk Verification
6 Implementation	Training Evaluations Work Systems Analysis Proactive Risk Management
7 Monitoring	Adverse Event Investigation In-Situ Testing Hazard Analysis

Usability Evaluation

Digital health is revolutionizing healthcare and making the intersection of technology and human interaction more essential than ever. It will take ongoing support and investment – backed by the right skills and knowledge – to better design and implement new processes and systems. With growth in digital health, the role of human factors is imperative to the safety of the technology and the patient and clinician experience.

Guidance for FDA Regulatory Submission

Our usability experts are continually working with the FDA and staying current on evolving requirements. We conduct evaluations for application of human factors to the design and development of medical devices and products to ensure compliance with FDA requirements. From assessing user needs, risk evaluation and critical task identification, to formative and validation stage user testing, our processes are designed to comply with the standards for FDA submission.

SPOTLIGHT STORY

50,000+ people

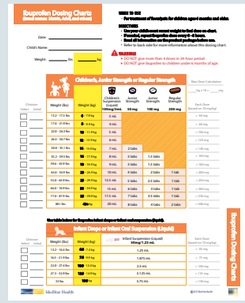
experience acute overdose of ibuprofen – a majority being children under six years old.

Source: American Association of Poison Control Centers' National Poison Data System

An 11-month-old brought into a MedStar emergency department with a high fever was prescribed ibuprofen. The parents were provided medication instructions along with a dosing chart. Once home, the father attempted to give the medication to the child and nearly resulted in an overdose when the mother, a MedStar associate, realized the amount instructed was intended for the children's, not the infant, formulation.

The confusion was brought to the attention of MedStar's Quality and Safety department, which engaged the Center in the revision of the dosing chart. The team conducted interviews to understand patient and clinician needs, identified risks and redesigned the dosing chart to be more intuitive and follow design the dosing chart guidelines. After a pilot period, the revised dosing chart was rolled out and now provides parents with clearer medication administration instructions.

Dosing Chart Before



Dosing Chart After

Safety Advisement

The Center's safety advisement program offers direct service to MedStar Health and external organizations with services such as safety hazard analyses and event reviews.

By taking the following approach to safety, we develop recommendations and solutions to design a safer and more efficient healthcare environment.

1 Proactive Safety Analysis

Our team works to proactively identify safety hazards and reduce risk before harm occurs.

- **Usability testing during procurement:** Assess medical devices and other technology for potential use errors.
- **Work environment analysis and optimization:** Analyze work environments for unsafe work processes that may contribute to future patient harm and provide recommendations or redesign for safer and more efficient care.
- **Safety and risk assessment:** Apply rigorous analytic and visualization techniques to identify trends in safety data and support prioritization of improvement processes.

2 Reactive Safety Analysis

Our team conducts in-depth analysis of harm events after they occur to identify contributing factors and develop solutions to help prevent future occurrences.

- **Event reviews:** Analyze the role of the physical environment, technology, culture and other system factors in relation to the harm event and provide recommendations for improvement.
- **Usability analysis:** Test products to determine how they may have contributed to a harm event and provide recommendations internally and to the product manufacturer.

3 Promoting Safety Culture

Our experts encourage a culture of safety through education and outreach.

- **Just culture:** Provide a foundation for a culture that supports open safety event reporting and risk mitigation, with a focus on system factors and not individual blame, through leadership engagement and workshops.
- **High reliability organizations:** Develop organizations that focus on consistent, reliable and safe practices through organizational change methods.

SPOTLIGHT STORY

Annie, a MedStar Health nurse, noticed a patient's glucometer reading appeared high and treated the patient based on that result. However, the patient's blood sugar was actually the exact opposite and the individual ended up in the ICU – all ultimately based on the glucometer's poor design and the improper treatment that triggered. The issue was discovered from an event review and rather than taking the blame and shame approach, MedStar Health shifted its attention to the design of the device. Its leaders asked the Center to not only examine the device but also the system within which the event occurred. As a result, the hospital is working toward finding solutions to prevent future harm and promoting a just culture. The most important outcome is that the patient fully recovered, and Annie was not blamed for the incident.

Education and Outreach

The Center's education and outreach programs are dedicated to training and mentoring the next generation of human factors experts, from partner organizations in the U.S. to institutions around the world, further increasing the innovative footprint of human factors.

Educational opportunities exist for different types of experience levels and learners – from medical students to attending physicians and from human factors students to practitioners.

The best kind of practicum is a mutually beneficial one, and MedStar afforded me the opportunity to contribute to a meaningful project while also giving me experience I could not have gotten just in the classroom.

Hannah Donnelly, 2018 Intern from George Mason University

It was inspiring to be a part of how MedStar conducts research and pursues healthcare challenges in a systematic and holistic way. The research experience coupled with supportive mentorship and the fun, innovative work environment at MedStar definitely set me on a path to pursue human factors throughout my medical career!

Anoosha Moturu, 2018 Intern from Baylor College of Medicine

What We Offer

To expand on the Center's mission to improve the quality, safety and efficiency of healthcare through human factors, we are dedicated to providing education and outreach initiatives, including:

1 Courses and Workshops

Our clinicians and human factors engineers work across sectors and offer formal instruction on the application of human factors in healthcare.

We work with industry partners to build topic-specific learning opportunities that can be offered for CME credits throughout the year. Applicable to a wide range of professionals, our courses and workshops benefit everyone from hospital system executives and software engineers, to human resources personnel and practicing physicians.

2 Expert Engagement + External Interactions

The Center is dedicated to generating and increasing knowledge about human factors. Through research, education and usability services, we emphasize a variety of approaches to outreach, including roundtable discussions, public presentations, expert panels and other networking opportunities to reach a wider audience. The Center is widely recognized for our work and contributions both domestically and internationally.

3 Student Program Mentoring

From high school students to PhD candidates and residents, we offer year-round mentoring opportunities for individuals seeking to learn about and gain hands-on experience with human factors. The Center's internship program recruits for limited positions every Fall, Spring and Summer and offers academic credit, if desired.

OUR GLOBAL REACH

From providing guidance on how to build a human factors program to preparing a medical device for market, we work with U.S.-based and international partners to improve safety, efficiency and quality.

CENTER HOME

Offers a fully accredited, fourth-year elective System Safety Engineering Course hosted through Georgetown University School of Medicine on the central concepts of human factors and system safety engineering in healthcare, and how to apply those concepts in the practice of medicine and future leadership roles.

SWITZERLAND

GERMANY

UNITED KINGDOM

Provides expertise to the U.K.'s National Health Service (NHS) on electronic health record usability and safety.

SPAIN

Helped create from inception to implementation, a human factors center for Valdecilla Hospital System, focused on usability, research and education.

ISRAEL

Partners with several companies to provide usability advisement and usability testing for FDA clearance.

SOUTH KOREA

Provided guidance to a South Korean medical center on how to conduct usability testing on medical devices and prepare them to obtain FDA clearance.

AUSTRALIA

Conducted workshops and performed usability services with healthcare systems on how to better integrate human factors into safety work within hospital system operations.

KEY

- Research
- Usability Services
- Education and Outreach

Without change there is no innovation, creativity or incentive for improvement. Those who initiate change will have a better opportunity to manage the change that is inevitable.

William G. Pollard

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