

# Introduction to Human Factors & Ergonomics (HFE) in Healthcare

## Why do things go wrong and right in complex systems?

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NHS Lothian



## Workshop Purpose

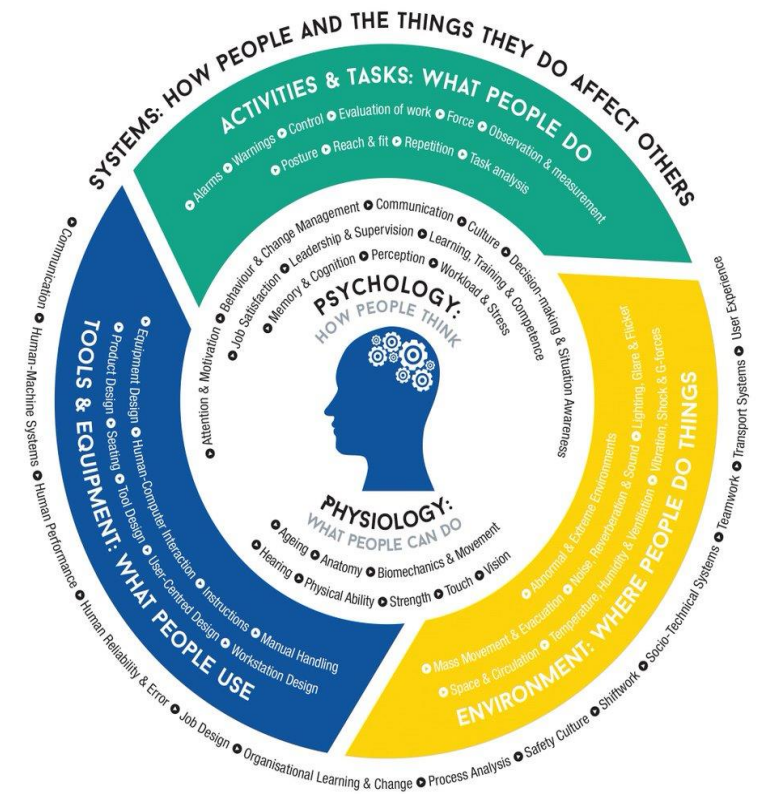
1. To raise awareness of the importance of HFE in healthcare
2. To explore specific HFE needs – workplace and educationally
3. To signpost to a range of NES resources to support HFE development

Please tell us what you understand by 'human factors' AND 'ergonomics?'

[small group work]

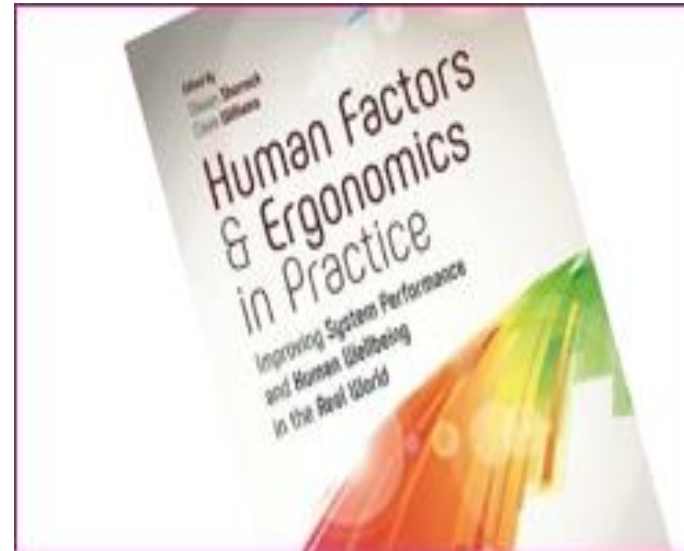
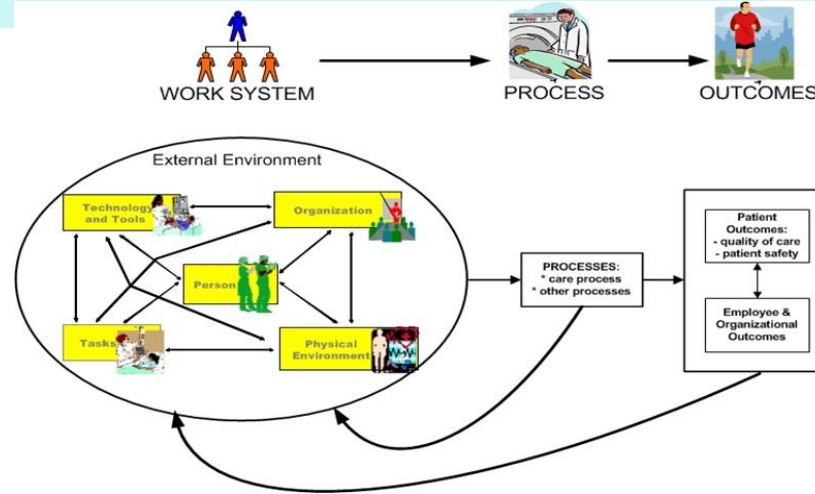
# Defining Human Factors/Ergonomics (HFE)

- “Ergonomics (or human factors) is...concerned with the **understanding of interactions among humans and other elements of a system...in order to optimize human well-being and overall system performance...**” (IEA, 2000)
- In other words, HFE is:
  - ‘*the study of factors that make work harder or easier*’
  - ‘*the study of how humans interact with their environment for useful purposes*’
  - ‘*designing for people to make things easier and safer*’
- **The settled will of the international HFE community!**

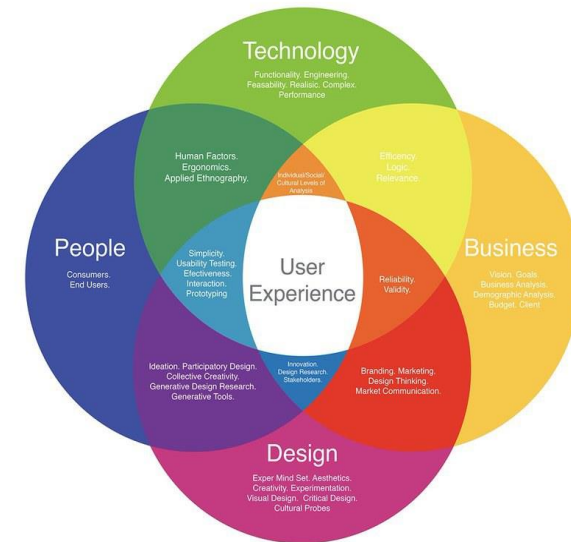


# Distinguishing features of the HFE approach:

1. It **ALWAYS** takes a **Systems Approach** (holistic)
2. It is **ALWAYS** **Design Driven** (to take account of human characteristics, needs, capabilities and preferences)
3. It focuses **ALWAYS** on two closely related outcomes: **System Performance** and **Human Well-being** (“Twin Aims” = “Joint Optimisation”)



## Human Centered Design



# Three Specialist Sub-Domains

## Physical e.g.

- Human anatomy
- Anthropometrics
- Physiology
- Biomechanics

Interactions of the user and the equipment used. Practical applications include:

- Workplace layout
- Working postures
- Materials handling
- Repetitive movements
- Work-related musculoskeletal disorder analysis.

## Cognitive e.g.

Processes affecting the user and user interactions with technology during task completion. These cognitive processes include:

- Memory,
- Reasoning,
- Perception
- Motor response

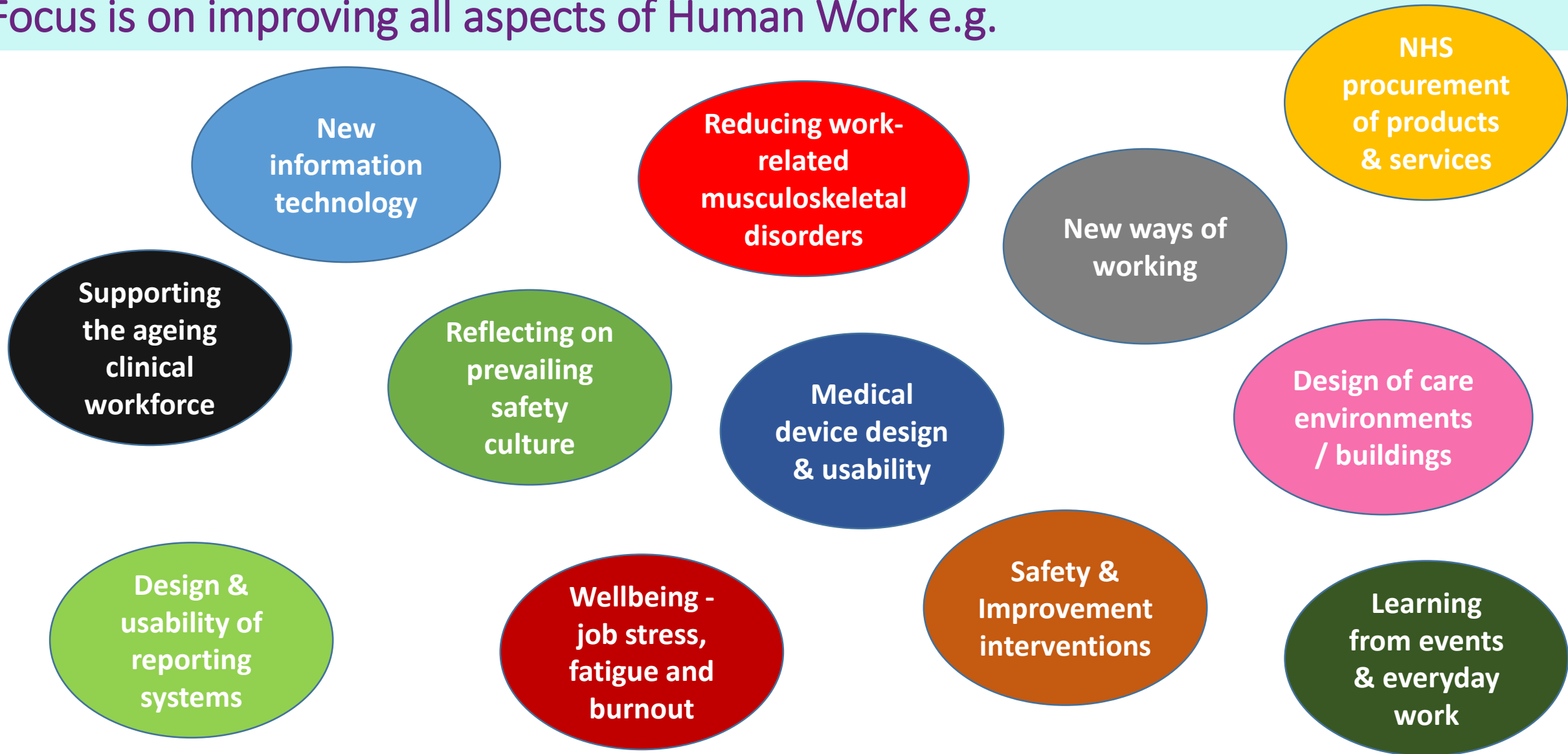
Practically applied to:

- Human–computer interaction
- Mental workload,
- Decision-making
- Skilled performance,

## Organisational e.g.

- Complex interactions within socio-technical Systems
- Organizational HFE focuses on holistic work system analysis and design by examining the factors that influence stakeholders work practices, that is, personnel, technology, environment, tasks, and work culture.
- Subgroups within these categories include teamwork, safety culture, supervision, shift work, scheduling, and job satisfaction

Wide ranging discipline -  
Focus is on improving all aspects of Human Work e.g.



# Other Industries

Human factors is a scientific discipline, with scientific methods, highly established in other safety critical industries:

- Nuclear
- Maritime
- Military
- Aviation
- Rail
- Surveillance
- Offshore industries
- Energy



# Human Factors Myths & Misunderstandings in Healthcare

BMJ Quality & Safety Online First, published on 30 November 2011 as 10.1136/bmjqs-2011-000421  
Viewpoint

## Time to accelerate integration of human factors and ergonomics in patient safety

Ayşe P Gurses,<sup>1</sup> A Ant Ozok,<sup>2</sup> Peter J Pronovost<sup>1,3</sup>

Downloaded from <http://qualitysafety.bmj.com/> on October 30, 2014 - Published by [group.bmj.com](http://group.bmj.com)

EDITORIAL

## Spreading human factors expertise in healthcare: untangling the knots in people and systems

Ken Catchpole

Downloaded from <http://qualitysafety.bmj.com/> on October 30, 2014 - Published by [group.bmj.com](http://group.bmj.com)

VIEWPOINT



OPEN ACCESS

## The science of human factors: separating fact from fiction

Alissa L Russ,<sup>1,2,3,4</sup> Rollin J Fairbanks,<sup>5,6,7</sup> Ben-Tzion Karsh,<sup>\*8</sup>  
Laura G Militello,<sup>9</sup> Jason J Saleem,<sup>1,2,3,10</sup> Robert L Wears<sup>11,12</sup>

1. Human Factors ≠ Factors of the Human
2. Human Factors ≠ Cause of failure
3. Human Factors ≠ Team Training
4. Human Factors ≠ Non-Technical Skills
5. Human Factors ≠ Crew Resource Management
6. Human Factors ≠ QI
7. Human Factors ≠ Clinical Skills
8. Human Factors ≠ Simulation

## SEPARATING FACT FROM FICTION

**Fact #1:** *Human factors is about designing systems that are resilient to unanticipated events.*

*Fiction: Human factors is about eliminating human error.*

**Fact #2:** *Human factors addresses problems by modifying the design of the system to better aid people.*

*Fiction: Human factors addresses problems by teaching people to modify their behaviour.*

**Fact #3:** *Human factors work ranges from the individual to the organisational level.*

*Fiction: Human factors is focused only on individuals.*

**Fact #4:** *Human factors is a scientific discipline that requires years of training; most human factors professionals hold relevant graduate degrees.*

*Fiction: Human factors consists of a limited set of principles that can be learnt during brief training.*



## Examples of Underlying HFE Principles

**The human factors** discipline promotes a fundamental rejection of the notion that humans are primarily at fault when making errors in the use of a socio-technical system.

Participatory Design

Systems Approach

Applying Design Knowledge  
(ISO...)

Mismatches  
(Identification & Understanding)

Interactions are Key  
(micro, meso, macro)

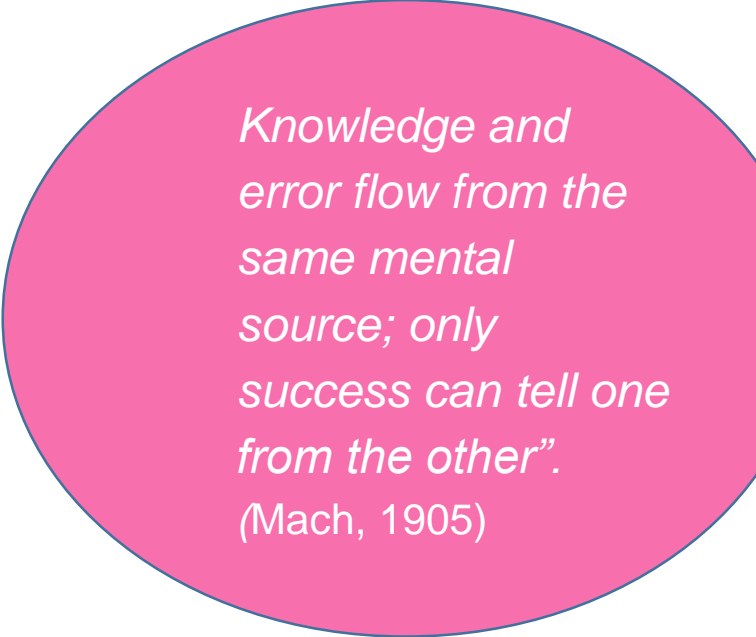
Closing the Gap  
(Work-as-Imagined v Work-As-Done)

# Why do you think things go wrong (and right) in complex healthcare systems?

[small group work]

## Key Principles - Understanding Why Things go Wrong (and Right) e.g.

- We don't go to work to do a **bad job** (axiomatic)
- The '**Human Error**' **problem** (misnomer, not a 'cause' but a symptom)
- Understand system complexity and interactions
- Accept things going wrong is '**normal**' (zero is a pipedream)
- **Local rationality** (i.e. decisions make sense based on available info/context)
- **Goal conflicts** (e.g. increase productivity Vs decreased resource)
- **Trade-offs** (e.g. safety Vs efficiency)
- **Performance variability** (e.g. adapting to context to get job done)
- Organisational **constraints** (e.g. resources, priorities, culture)
- Safety - **emergent property** – safety is not inherent, people create it

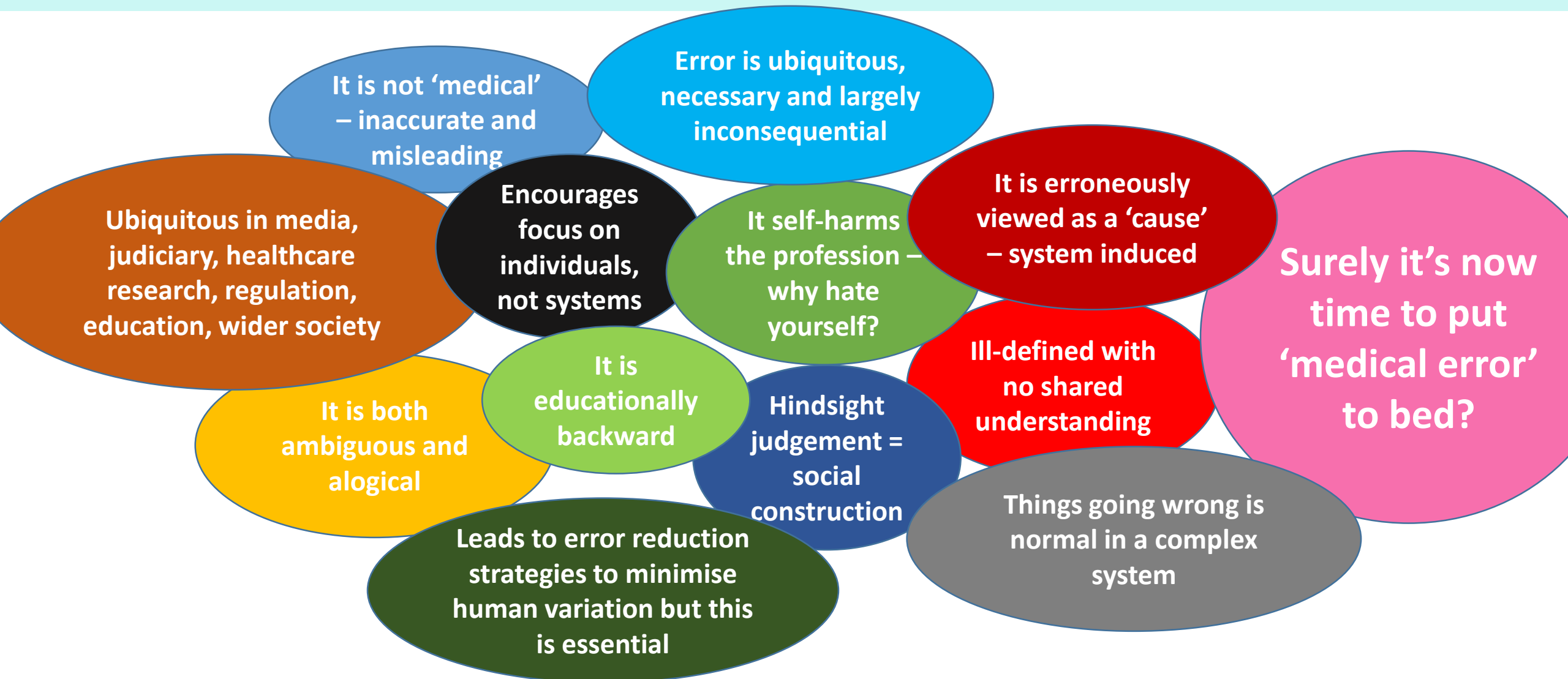


*Knowledge and error flow from the same mental source; only success can tell one from the other".  
(Mach, 1905)*

‘Medical Error’ is ubiquitous in healthcare policy documents, educational curricula and health services research worldwide.

**What is the problem with ‘medical error’**  
(and its synonyms ‘nursing error’, ‘pharmacy error’, ‘human error’...)?

# M&M and Policy Literature – The Problem with “Medical Error”



# The Blame Game

- Natural human tendency (you and others)
- Blaming is the opposite of learning
- Can't fix problems unless we admit they exist
- System-induced issue – you're not an idiot or bad or worse!
- When we blame, we focus on the person and not the system design

*“I knew better...It was my fault”*

- Not a valid analysis, doesn't help prevent recurrence





**Stu Marshall** @hypoxicchicken · 1 Dec 2018

Replying to @patientsafe3 @DrGetafix @NicholasChrimes

Here fixed it for you @Tennessean

You're welcome.

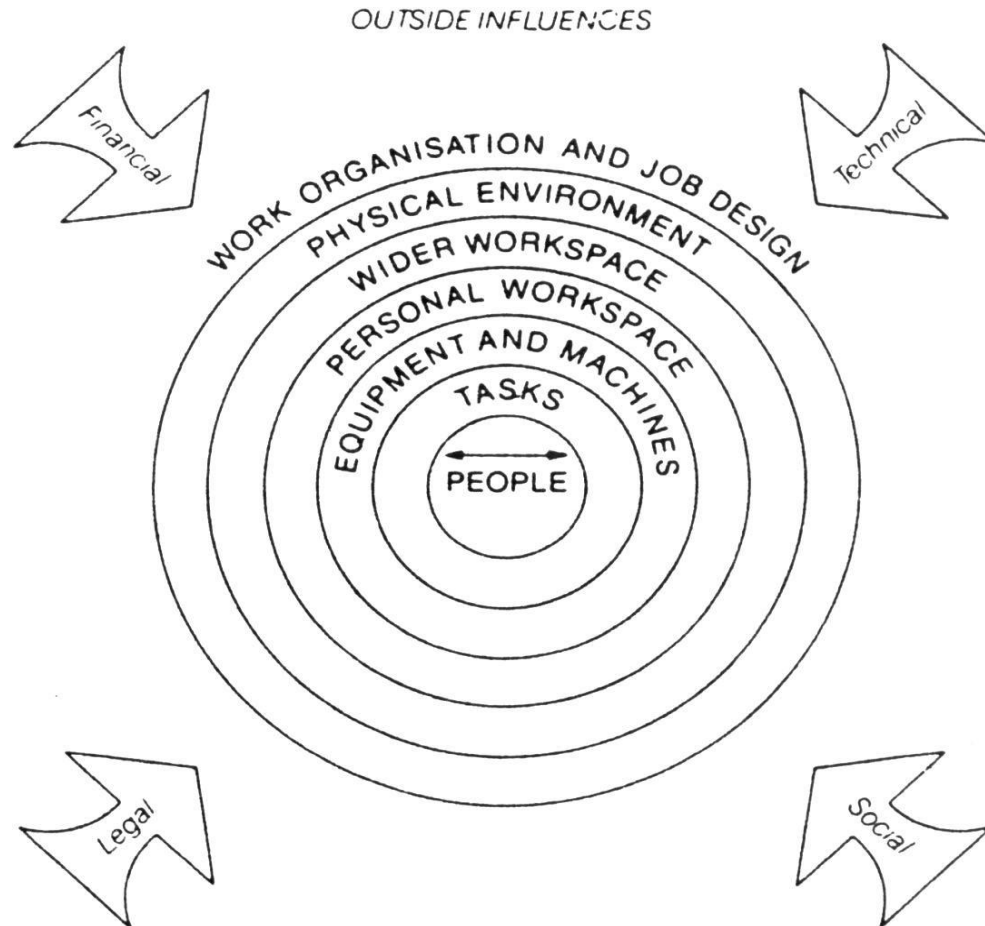
*medication administration process that allowed a nurse to give a muscle relaxant rather than a sedative*

**At Vanderbilt, a ~~nurse's error~~ killed a patient and threw Medicare into jeopardy, *then threw nurse under a bus***

[Brett Kaiman](#), Nashville Tennessean

Published 11:00 a.m. CT Nov. 29, 2018 | Updated 7:25 p.m. CT Nov. 29, 2018

# Interactions within systems of work

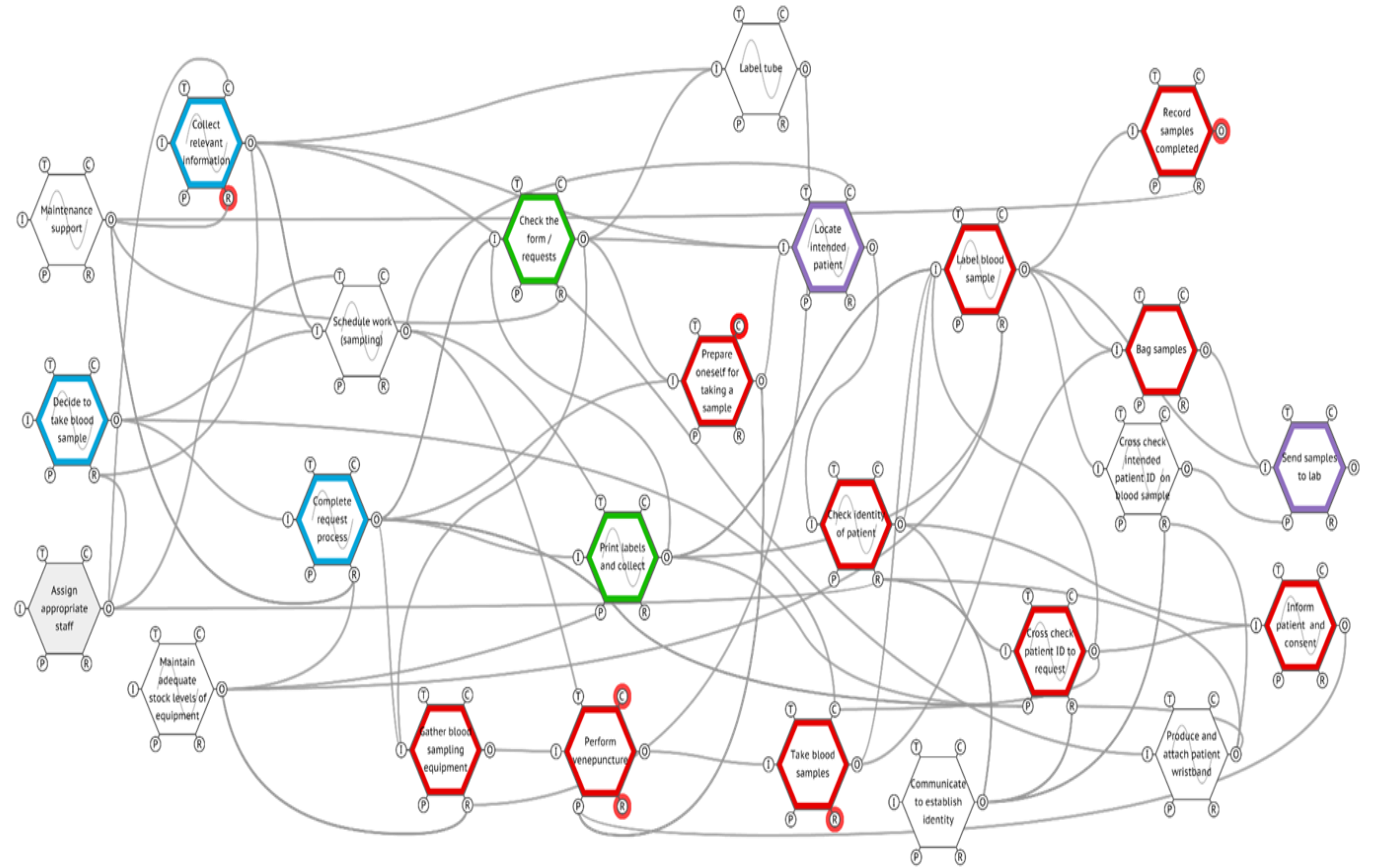
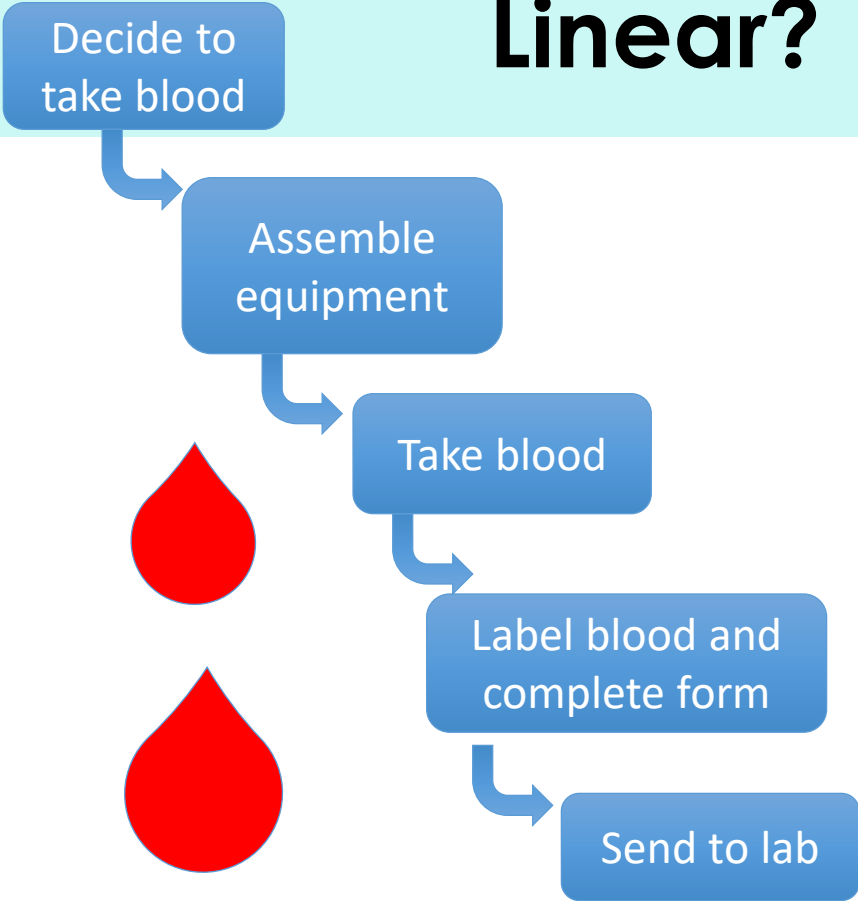


We take what we know about people's characteristics and abilities, often from the theories and knowledge obtained by other disciplines such as psychology and social science, and **APPLY** it to the design of the world we live/work in.

In what ways is healthcare 'complex'?

# Linear?

# Complex?



“Simple” Act of Taking blood

Pickup L, Hollnagel E, Bowie P *et al.* Blood sampling - Two sides to the story. *Applied Ergonomics*. 59. 2017; 234–242

# Importance of Human-Centred Design

HFE key to good design – focus on systems in which people interact



## Why design starts with people

Sue Hignett



*Design knowledge – use error – task analysis - interactions – high risk situations – devices – tools – drugs – packaging – standardisation – conventions – international design standards – purchasing decisions – life-cycle costing – evaluating ease of use – usability criteria – design guidelines – stakeholder conflicts of interest – risk assessment training – usability heuristics*



### DESIGN FOR PATIENT SAFETY

**A SYSTEM-WIDE DESIGN-LED APPROACH TO TACKLING PATIENT SAFETY IN THE NHS**

This report sets out a perspective from the world of design – based on a scoping study carried out by a research team from the Universities of Cambridge and Surrey and the Royal College of Art – to identify previously unrecognised opportunities for improved patient safety in the NHS.



# Design and Usability

## Poor Usability and the Risk of Mode Errors with the Lifepak 20e Defibrillator



# Design and Usability

- Poor Usability and the Risk of Mode Errors with the Lifepak 20e Defibrillator

[https://www.youtube.com/watch?v=vyQ\\_af3CvwE&feature=youtu.be](https://www.youtube.com/watch?v=vyQ_af3CvwE&feature=youtu.be)

# Human Factors Design Principles at Work

## Examples of Good Designs

What makes scissors so easy to use?



What do you think these signs say?



What makes the first two designs better than the last?



Which remote is easier to use?  
The one on the left or the one on the right?





## Violations of Human Factors Design Principles

### Examples of Bad Designs

This remote uses the letter “v” for volume control and a “ch” for channel controls. Unfortunately, a “v” also looks like a down arrow.



Which side displays speed?



It may take more than a quick glance to determine how fast you are going. Both MPH (left) and RPM (right) are displayed in units of 10.

How would you open this door?  
Most doors with a pull handle are designed to be pulled, and this is what people are used to doing. However, this door is different.



What system/technology design issues irritate  
or frustrate you in your workplace?

[open discussion]

# Design Issues - MRI Working Environment (See Handout)

- The MRI **work system environment** poses a significant **risk of harm** to patients, frontline care practitioners and others
- But knowledge of **hazards** and potential design improvements are limited as safety research is lacking – significant under-reporting.
- The purpose of this exploratory study was to understand how the discipline of **Human Factors** can support the understanding, management and improvement of **safety and performance** in MRI working environments



# How can I apply Human Factors thinking?

A few basic Human Factors principles can be readily implemented 'as a way of thinking and practice' by frontline clinicians, scientists, engineers, managers, staff groups and others e.g.

- When investigating why something has gone wrong
- When implementing new ways of working/technology
- When looking for hazards (anything that can cause harm to you or patients, or others within your workplace).
- When undertaking a quality improvement project
- Everyday problem solving, no matter where you work in healthcare.
- Selecting, buying and evaluating new equipment

# 5 Basic Principles

- 1. Talk to ALL relevant frontline staff who actually do the job**
- 2. Think about what can go wrong**
- 3. As far as possible, simplify and standardize**
- 4. Always take a system wide perspective**
- 5. Focus on how we can design to make it easier, safer and more efficient for us**

# Where is Scientist education & training with regards to embedding HFE thinking and methods?

[open discussion]

# Further Resources

- [Entry-level e-learning](#)
  - [Workshops](#)
- [National Development Group](#)
  - [\(catrina.gordon@nes.scot.nhs.uk\)](mailto:catrina.gordon@nes.scot.nhs.uk)

<https://learn.nes.nhs.scot/800/patient-safety-zone/human-factors>

<https://www.ergonomics.org.uk/>



Safety, Skills & Improvement  
Patient Safety

## Patient Safety Zone

All Patient Safety Zone

[Learn Home](#) > [Patient Safety Zone](#) > [Human Factors](#)

← Patient Safety Zone

Human Factors

Examples

Managing error

Resources

Safety I and safety II

Scoping review of human factors and ergonomics issues

## Human Factors

Introducing human factors, tools for managing error and resources for further information and guidance.

### Human Factors

Human Factors (Ergonomics) is the study of human activity (inside and outside of work). Its purpose as a scientific discipline is to enhance wellbeing and performance of individuals and organisations. A number of different definitions of Human Factors exist. The key principles are the interactions between you and your environment both inside and outside of work and the tools and technologies you use.



human factors

# THANK YOU

## Any Final Questions?

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[Nadine.Wilkinson@nhslothian.scot.nhs.uk](mailto:Nadine.Wilkinson@nhslothian.scot.nhs.uk)