An Introduction to Human Factors for Healthcare Workers

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Version 1

Reader Information

Foreword

Human factors as a discipline can trace its origins to the military, the aviation industry, and computer hardware and software design. In essence, an appreciation of human factors can help us to better develop safe practices and systems, accounting for the complexity of how people interact with tasks, technology and the environment. The content of this guide encompasses a broad range of issues and it is envisaged that the overall human factors approach is equally valuable for primary, secondary, community, and pre-hospital care.

As the National Clinical Director for Quality and Patient Safety, I am delighted to present 'an introduction to human factors for healthcare workers'. I welcome this addition to the evidence base that underpins our collective approach to ensuring safe, efficient and high quality care is delivered throughout the healthcare system.

This guide has been written for all healthcare workers. The primary aim is to provide staff with an understanding of the principles and application of human factors and how it can be used to improve safety in healthcare. Part one of the guide comprises nine chapters that describe specific aspects of the interaction between humans and the healthcare system, and the potential to use this lens to design safer processes, systems and work environments. Part two considers the application of human factors to healthcare and includes a chapter on incident review and a chapter that presents examples of human factor interventions.

It is necessary for healthcare to adapt and change as the needs of the population changes. As new processes and systems are developed, the application of the principles of human factors in redesigning healthcare will help to ensure that we continue to provide safe care to the people we serve.

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National Clinical Director
for Quality and Patient Safety

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Overview

Purpose of this guide

The purpose of this guide is to provide an introduction to human factors for healthcare workers. As this guide is written for all healthcare settings (primary, secondary, community, and pre-hospital care), it is not focused on any one particular domain of healthcare. The content of this guide draws upon the human factors research literature. The recommendations in this guide may not necessarily always match current Health Service Executive (HSE) policies. However, these recommendations should still be considered within the context of local and national policies, procedures, guidlines, legislation, and regulations that relates to patient/service user safety and quality of care.

It is important to state that the human factors challenges are not the same for every domain of healthcare. By way of illustration, obviously surgery is quite different from community care, a different approach will be required for each. Moreover, even within a particular domain of healthcare there will be different issues depending on the context. For example, the human factors issues in the Intensive Care Unit (ICU) in one hospital are unlikely to be the same as those in the ICU of a different hospital. Human factors, similar to any quality improvement effort, is not a 'one size fits all' approach. Rather a careful process of understanding the problem within the organisation or unit is crucial before any human factors interventions are initiated.

> **This guide will:**
> - **provide a comprehensive overview of human factors;**
> - **support healthcare workers to identify the human factors issues in their workplace;**
> - **support the identification of the human factors contributors to incidents; and**
> - **provide examples of human factors interventions that have been used in healthcare settings.**

Structure of this guide

Part one of this guide is concerned with providing a foundation in human factors knowledge. This is structured using the **sociotechnical system model** [1]. A sociotechnical system is a system in which humans and technology interact. As can be seen from the figure below, the sociotechnical system model shows the healthcare system as a layered system where patient/service user factors; work

environment factors; individual healthcare worker factors; healthcare team factors, organisation and management factors; and society, culture and regulatory factors interact and affect the quality and safety of patient care. This guide contains a chapter on each of the levels of the sociotechnical model.

Part two considers the application human factors methods and approaches to incident reviews (chapters 10), and examples of human factors interventions (chapter 11).

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References

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Chapter 1.

What is human factors?

Introduction

Most people involved in healthcare are familiar with the term 'human factors'. However, most healthcare professionals have had little formal training in human factors and their understanding is often based on an aviation model that is focused on improving teamwork and communication. Although this is certainly one aspect of human factors, it fails to address the full range of human factors approaches, knowledge, and techniques that can be applied to improving the delivery of healthcare [1,2].

Why should I read this chapter?

Healthcare workers should read this chapter as it provides an overview of the breath and scope of human factors and describes the organisation of this guide.

What is human factors?

There are many different definitions of human factors. However, a widely accepted definition is: "*the environmental, organisational and job factors, and human and individual characteristics which influence behaviour at work in a way which can affect health and safety.*" [3](p.2). A simple way to view human factors is to think about three aspects- the job, the individual, and the organisation- and how they impact upon people's behaviour.

Human factors has been described as a bridging discipline. It establishes common ground between humans and their working environments [4]. Human factors draws upon many fields such as psychology, anatomy, physiology, social sciences, engineering, design and organisational management [5]. Human factors uses a wide range of theories, measures, and approaches in order to improve the safety, quality and efficiency of workplaces. Human factors is particularly important in healthcare as it is characterised by high levels of human-to-human as well as human-to-technology interactions [4].

History of human factors in healthcare

Human factors originates from the study of aviation mishaps and the design of pilot controls during World War II. In healthcare, there are a small number of references to human factors in healthcare prior to mid 1990s. It was not until James Reason's 1995 and 2000 papers on understanding adverse events [6] and human error [7], and the U.S. Institute of Medicine report 'To Err is Human', published in 2000 [8], that the healthcare industry became interested in human factors. This interest started in anaesthetics (arguably because this specialty of medicine is most comparable to aviation), but now human factors permeates all specialities of healthcare.

The impact and benefit of human factors in healthcare

In healthcare, the focus of human factors has been to improve patient/service user safety. However, human factors also has much to offer to the areas of quality improvement and efficiency.

- **Safety improvement**- a human factors approach can support our understanding of the contributors to incidents at all levels of the healthcare system, as well as how to proactively improve safety through mitigation.
- **Quality improvement-** human factors approach can support improvements in quality of care, work practices, and workforce satisfaction.
- **Increased efficiency-** a human factors approach can support an improved understanding of how work processes and systems can be designed in order to optimise performance, productivity, and cost effectiveness.

Conclusion

In the same way that human factors approaches have transformed other high-risk industries, there is great potential for human factors approaches to positively impact the healthcare industry. Human factors practitioners use a wide range of theories, measures, and approaches in order to improve the safety, quality and efficiency of workplaces; the appropriate strategy and approach will depend on the problem situation and the context. There are no 'one size fits all' solutions.

Practical implications

- The application of human factors principles and methods to healthcare has the potential to improve safety, quality, and efficiency.
- Human factors can benefit patients/service users, and those that care for them.

Online resources

- The Clinical Human Factors Group: chfg.org
- The Irish human factors and ergonomics society: ihfes.org
- The Chartered Institute of Ergonomics and Human Factors (UK): www.ergonomics.org.uk

- The Human factors and ergonomics society (US): www.hfes.org/

Additional Readings

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Part 1
Foundations of Human Factors in Healthcare

Chapter 2.
Patient/ Service users

Introduction

Patients/service users are at the centre of the healthcare system. They bring their own complexity, preferences, personality, and wishes that should be considered and acknowledged as part of their care. Patients/service users are no longer willing to accept the traditional (paternalistic) model of the past where they are the passive recipients and healthcare providers have all of the information and make all of the decisions. Patients/service users have greater access to information about their health than ever. This makes them more willing to be involved and eager to take an active role in decision making about their health. Moreover, patient/service user involvement can extend beyond their own immediate care, to include their involvement in patient safety more generally. In recent years, there has been a growing recognition that patients/service users can be a powerful driving force for safety improvement beyond their own individual care.

Why should I read this chapter?

This chapter will cover the changing role of patients/service users in their own care and the need for healthcare providers and organisations to modify and transform in order to meet these needs.

The evolving relationship between patients/service users and healthcare workers

The traditional model of medicine, in which patients/service users are the passive recipients of care, has slowly been changing to a model in which patients/service users and healthcare workers form a partnership toward the common goal of improved health. In this model, patients/service users are recognised to be informed, have values and expectations, and able to make decisions about their care. This changing relationship between patients/service users and healthcare workers requires a shift in attitudes, behaviour and culture of both patients/service users and healthcare workers. For health care workers this new relationship requires a more open, informative and participative style of interaction with patients/service users.

Person-centred care

The model of care in which patients/service users and healthcare workers are partners in the therapeutic relationship is called 'person-centred care'. A range of other terms are also used to refer to activities with similar principles such as 'patient-centred care' or 'relationship-centred care'. In this guide we use the term 'person-centred care'. The word 'person' is used to emphasise a holistic approach to care that takes the whole person into account, rather than focusing on the illness or disease [1]. Healthcare organisations that have adopted a person-centred approach have more positive outcomes, such as greater satisfaction with care, greater job satisfaction among healthcare providers, increased quality and safety of care, and greater quality of life and well-being of patients/service users [2]. The goal of person-centred care is to empower patients/service users to actively engage in their care, in partnership with healthcare workers [3].

Example of person- centred care
It has been found that autism is associated with increased mortality and morbidity [4]. However, poor health is not an inevitable consequence of autism but instead reflects health inequities experienced by autistic persons [4]. Swartz et al [5] describe an intervention in which an individualised plan was developed for autistic children scheduled for anaesthesia. The plan was prepared by the hospital staff and the patient's caregiver, and where possible the patient. The plan was intended to serve as a management guide available to all hospital personnel to optimize perioperative patient cooperation and avoid harm. The plan covered factors such as: the identification of the optimal time of day for procedure, modification of hospital arrival time, avoidance of multiple transitions, limitation of admission procedures, use of distractors etc. The intervention received positive feedback from caregivers, and was found to be useful in guiding the choice of sedative by the anaesthetist.

Developing a person-centred healthcare organisation

Despite the potential benefits of person-centred care, little is known about how best to transform a traditional, provider-centred healthcare system into one in which patients/service user preferences and goals drive care. In 2010, the U.S. Department of Veterans Affairs embarked on just such a mission. Their aim was to transform a traditional healthcare system to one that provided personalised, proactive, and person-centred healthcare [3]. It was found that person-centred care is more than just changing the conversation and interactions between healthcare workers and patients/service users. Rather, these interactions are shaped by the systems and contexts in which they occur. Therefore, transforming a healthcare system to serve the 'whole' person requires a multi-faceted approach including cultural transformation at all levels within the organisation [6]. Achieving person-centred care requires informed and involved patients/service users, receptive and responsive health workers, and a supportive organisational culture [7] (organisational culture is discussed in more detail in Chapter 8 of this guide).

The Calgary-Cambridge model

Effective person-centred care is facilitated when healthcare workers use good communication skills and techniques (communication is discussed in detail in Chapter 6 of the guide). The importance of communication in obtaining good health outcomes is well established [1,7,8]. The Calgary Cambridge model presents a structure and associated skills to facilitate good communication between healthcare workers and patients/service users [9].

One of the main purposes of the Calgary Cambridge model is to help healthcare workers to integrate communication (process) skills with their clinical (content) skills, simultaneously. Process skills include:

- Structuring the consultation.
- Building the relationship.

Content skills include specific skills associated with each of the five stages of a patient/service user consultation.

1. Initiating the session.
2. Gathering information.
3. Physical examination.
4. Explaining and planning.
5. Closing the session.

In structuring a consultation, the healthcare worker must make the structure of the consultation overt and attend to the flow of the consultation. Relationship building involves behaviours such as developing rapport, using verbal and non-verbal communication and involving the patient/service user in decision making.

Specific skills are associated with each stage of the consultation. In the early stages, the focus is on developing rapport and understanding the patient/service user's perspective. Important skills include attentive listening, picking up cues, and clarification. Appropriate use of language and empathy are important. In the middle stages, the healthcare worker is concerned with identifying the biomedical perspective as a well as the patient/service user's perspective including their beliefs, values, concerns, expectations, and social context. Skills of open and closed questioning are also important at these stages. The latter stages of the consultation requires a slightly different set of skills such as providing the correct amount and type of information, aiding accurate recall, achieving a shared understanding, and incorporating the perspective of the patient/service user. The Calgary-Cambridge model is central to the HSE's National Healthcare Communication Programme [10].

Patients/service user involvement in safety improvement

In recent years, there has been a recognition of the contribution that patients/service users can make to patient safety. This contribution can be through: (i) enlisting patients/service users in detecting errors; (ii) empowering patients/service users to manage and oversee their own care; (iii) feedback through patient/service user experience surveys or analysis of patient complaints; and (iv) patient/service user involvement in safety initiatives and culture change initiatives.

Enlisting patients/service users in detecting errors. Including a patient/service user as a care team member can improve the safety and quality of care that the patient/service user receives. The patient/service user is a valuable information source because they are the only member of the care team that is present at all times during the care and across all of the care episodes. When patients/service users are fully informed about their care they can act as a valuable last line of defence against safety incidents. Implicit in this role is the need for a shared understanding between the patient/service user and the healthcare worker about risks and expectations. It is well documented that patients/service users are willing and able to report on what they perceive to be safety incidents in their own care [11]. Often these incidents are not reported elsewhere and so this insight represents a valuable source of safety data for the healthcare organisation.

Empowering patients/service users to manage and oversee their own care. An informed and empowered patient/service user is willing and able to take a greater role in their care. For example, through involvement in decision making about their care, management of their medicines, and even administering their own health interventions. This empowerment is of great importance with the increasing move towards care in the home. For example, dialysis services are increasingly taking place in the home rather than in the hospital. This is a positive development for patients/service users who can maintain a better life balance by having their treatments at home rather than in the hospital. By default, the patient/service user then becomes more responsible for their own safety. However, to be effective, there is a need for high level of partnership between the patient/service user and the health care team.

Patient/service user feedback. There are now a myriad of ways that patients/service users can provide feedback to the health service. For example, the St. James' hospital patient representative group meets monthly with the goal of helping staff to see the hospital from a patient/service user perspective [13]. Other formal feedback mechanisms include patient/service user experience surveys or patients/service user complaints systems. Evidence has shown that patients/service users are willing to provide feedback about the safety of their care [11].

Improving patient experience of the Emergency Department in Tallaght University Hospital

Based upon feedback from the Irish National Patient Experience survey the waiting area of the Emergency Department (ED) in Tallaght University Hospital was redesigned. The purpose was to improve communication between patients and healthcare workers. Improvements were made in order to:

- prevent others overhearing confidential information: an area of reception was configured such that only the patient registering in the ED can enter;
- provide information to patients on the ED process: information posters and a rolling electronic infogram are placed in the waiting room; and
- reassess and reassure patients: the triage nurse carries out a roll call at the start and end of each shift, and re-triages patients during the night [13].

Patient/service user involvement in safety initiatives and culture change. Patients/service users can contribute to healthcare improvement as they can identify improvement areas that are unseen by healthcare workers. For example, evidence shows that patient/service user involvement can highlight the need to approach care in a holistic way rather than through separate functions and settings [14]. Patients/service users do not experience care in a compartmentalised way and they may not understand the distinction between specialties and services. This understanding is particularly important given that the transition between one healthcare setting and another is a particularly risky time for patients/service users. This means that health services need to be more creative in involving patients/service users more actively across systems, pathways and transitions of care. Person and family engagement is one of the key drivers of the HSE's Framework for Improving Quality in Healthcare [15].

Challenges to patient/service user involvement in safety. Although patient/service user engagement is a promising strategy for safety improvement, there are several challenges to this endeavour. First, is the readiness of patients/service users to embrace this new role. Not all patients/service users want to be involved in care decisions or to take responsibly for their own safety. It is difficult for healthcare workers to predict the level of involvement desired by each patient/service user. This results in an extra burden on the health care provider to determine the patient/service user's willingness and ability to be involved.

Second, is the readiness of health care providers to embrace new roles. Patient/service user involvement represents a departure from a paternalistic healthcare system. These new types of relationships require healthcare staff to relinquish some control to patients/service users, which they may not be comfortable doing. The HSE's Patient Safety Strategy 2019-2024 outlines actions such as education and training for both patients/service users and staff to support these changing roles [11].

Practical implications

- Consider how to take a person-centred care approach in the unit in which you work.
- Consider how to involve patients/service users in safety improvements.

Conclusion

Person-centred care is a key determinant of quality of care. Research has shown that organisations that provide person-centred care report better patient/service user and organisational outcomes. In addition, person-centred healthcare workers report high levels of job satisfaction and satisfying relationships with their patients/service users. Embracing a new role for patients/service users can be difficult for healthcare workers as it can involve letting go of well-tried practices and habits and embracing new ways of interacting. Accepting that patients/service users need to know, are allowed to know, and can understand the very concept of safety is fundamental to improving safety in healthcare [12].

Further readings

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- The Health Foundation (2016). *Person-centred care made simple: what everyone should know about person-centred care*. London: Author. Available from: www.health.org.uk/sites/default/files/PersonCentredCareMadeSimple.pdf

Online resources

- Agency for Healthcare Research and Quality (AHRQ): Patient Safety Network (PSnet). See: psnet.ahrq.gov/primer/patient-engagement-and-safety
- The Health Foundation. See: www.health.org.uk/publications/quick-guides
- The HSE National Healthcare Communication Programme has a number of useful web-based support materials (e.g. videos, case-studies, skills cards). See: www.hse.ie/nhcprogramme.

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Chapter 3.

Work environment and equipment

Introduction

People prefer workplaces that are comfortable and safe, with equipment and procedures that are easy to use. Achieving such a workplace requires a consideration of the science and art of ergonomic design. Ergonomics is the scientific discipline concerned with understanding the interactions between humans and other elements of a system. Ergonomics encompasses how humans interact with hardware (e.g. medical devices, computer displays), software (e.g. procedures, computer programmes), and workspaces. It has been suggested that "*a user interface is like a joke, if you have to explain it, it's not that good*" (attributed to Martin LeBlanc). The design of equipment and workspaces is important in order to reduce the likelihood of error.

Why should I read this chapter?

This chapter will consider workplace design, and the principles of design for visual displays, auditory displays (alarms), and medical devices. A consideration of the design of workplaces and medical devices can ensure that they support, rather than inhibit, healthcare workers' ability to provide care.

Workplace design

Healthcare workers come in all different shapes and sizes. A failure to consider this variation in workplace design is one of the most common causes of error, fatigue, and discomfort [1]. There are four main principles that designers use when designing workspaces and equipment to match human physical characteristics:

1. **Design for the smallest.** This principle applies primarily to tasks that require strength/force, or require reach. Generally, at least 95% of the expected population should be accommodated in the design.

2. **Design for the largest.** This principle applies primarily to clearances, such as walkways, and overhead clearances. At least 95% of the expected population should be accommodated.
3. **Design for the average.** This principle applies to workstations that are not adjustable (e.g. fixed height tables, desks, or other work surfaces). In these situations, designing for the 'average person' better accommodates the entire population.
4. **Design for the range.** This principle is applied to determine the amount of adjustability that should be built into such things as variable height work surfaces and workstation seating (e.g., horizontal and vertical adjustability). In general, the dimension criteria used for designing adjustability readily accommodates the middle 90% of the population.

At the end of this chapter, we provide a link to an excellent ergonomics good practice case study carried out by the National Ambulance Service.

Medical devices design

Healthcare workers use a huge range of medical devices- some of which may have error provoking designs. To illustrate from 2005 to 2009 around 56,000 adverse drug events associated with the use of infusion pumps were reported, with many of these errors attributed to issues with the design of the user interface [2]. Recent European medical device regulation addresses the need for usability testing within the context of risk management. This reflects the recognition of the need for more effective, safer, and easier-to-use medical devices [3]. It is hoped that these regulations will have a positive impact on the usability of medical devices in the future. However, consideration should still be given to both avoidance and mitigation of ergonomic issues with medical devices. The following strategies should be considered:

- **User involvement.** End users should be involved in purchasing decisions for medical devices, and design decisions for any changes to a workplace.
- **Ergonomic assessment.** Use the information presented in this chapter to support decision making around the purchase of medical devices.
- **Standardisation.** As far as possible, there should be standardisation of medical devices in particular clinical environments. This means that healthcare workers do not need to learn how to use multiple devices.
- **Test equipment prior to deployment**. It is crucial that any equipment is tested in a simulation or actual clinical environment prior to deployment. This approach allows end users to test the device, and evaluate the interoperability with other devices.
- **Awareness of error provoking design**. Use the information presented in this chapter to identify error-provoking design in your workplace. Multidisciplinary teams should be established with the purpose of tackling ergonomic issues in clinical environments.

Design of displays

Displays are integral to many medical devices. The main types of displays are visual displays and auditory displays (more commonly described as alarms). The principles for the design of visual and auditory displays are provided below.

Visual displays

Visual displays are common in healthcare. This is not just electronic monitors, but also signs and labels. However, these displays may not be designed with the end user in mind. The following thirteen principles of display design should be considered when designing visual displays [1].

1. **Displays should be legible.** The user must be able to read a display under the conditions in which they are using it.
2. **Avoid absolute judgment limits.** Instead of gradual colour changes to indicate variation (e.g. differing shades of red), a more distinct range of colours should be employed.
3. **Top-down processing.** Users will perceive and interpret displays in accordance with what they expect to perceive based on past experience. For example, in Ireland a light switch is on when in the up position, but in the US this position represents off.
4. **Redundancy Gain.** This is where the same message is conveyed in more than one way. For example, traffic lights use both colour (red, amber, green), and position (top, middle, bottom) as indicators.
5. **Discriminability.** When different information is displayed in a similar way, this can cause confusion and error. For example, there are many examples of different drugs being labelled similarly, this can be error-provoking (see the example below).

Discriminability example: Wrong drug selection

During an out-of-hospital resuscitation in Canada, a paramedic mistakenly selected and injected morphine instead of adrenaline/epinephrine. It was recommended that when stocking an ambulance, it is important to choose products and packaging with easy to read labels (e.g., prefilled and labelled syringes instead of ampoules). The practice of removing individual vials and ampoules from their outer packages for storage in an ambulance improves access to medications in emergencies. However, this practice can also contribute to drug selection errors [4].

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6. **Principle of pictorial realism.** The display should look like what it is representing. For example, a higher temperature on a mercury thermometer is indicated by a line further up the thermometer than a lower temperature.
7. **Principle of the moving part.** The display should move in the same way as what it is representing (as is the case with a mercury thermometer).
8. **Minimising information access cost.** It should not take effort, or time, to find the required information source. The most important information should be readily available (e.g. on a patient monitor).

9. **Proximity compatibility principle.** Sometimes two or more sources of information must be mentally integrated. Therefore, these sources of information should be displayed together (e.g. heart rate and blood pressure)

10. **Principle of multiple resources.** Dividing information display across modalities such as providing visual and auditory warnings (e.g. ambulance siren and lights).

11. **Replace memory with visual information**. An example of this principle is changing the colour of text, or flashing text when something is outside normal parameters. This means the healthcare worker does not need to rely on their memory of the normal parameters.

12. **Predictive aiding**. A predictive aiding display uses an algorithm to provide some insights as to what will happen in the future. Algorithms can be used to warn healthcare workers of how likely particular events and outcomes may occur. Although not strictly a medical device, early warning score systems (e.g. National Early Warning System; NEWS) are examples of a method for early detection of deteriorating patients.

13. **Principle of consistency.** Use consistency in the way in which information is displayed across different information displays (e.g. regardless of the particular brand of patient monitor, the information should be displayed in the same way).

The Broselow system described below makes great use of many of these display principles.

> **Broselow paediatric emergency tape and system**
>
> A clever use of a colour display is the Broselow paediatric emergency tape and system. A child's length is measured using a tape with eight bands of colour corresponding to different heights (used as a proxy for weight). Once one of eight colours is assigned to the child, this colour is used to identify equipment of the appropriate size, inform medication dosages, and the voltage when using a defibrillator. Having colour coded, pre-selected packs of appropriately sized equipment and medications saves time in an emergency, and reduces the cognitive load on healthcare workers. This system obeys the principles of legibility, avoids absolute judgement limits, and most importantly minimises access cost by replacing memory with visual information.

Auditory displays (alarms)

Auditory alarms are designed '*to indicate unsatisfactory physiological patient states, unsatisfactory functional states of medical electrical equipment or medical electrical system or to warn the operator of hazards to the patient or operator due to the medical electrical equipment or medical electrical system*' (p8)[5]. The U.S. Joint Commission has included alarm safety as a patient safety goal [6] However although alarms are supposed to improve patient safety, a number of problems with alarms in healthcare have been identified [7].

- **Alarm handling.** As the threshold for alarms is often set low, there are a high frequency of low priority alarms in healthcare. It has been found that there can be > 900 alarms per day in clinical environments [7]. The high frequency of low priority alarms can interfere with team communication, and distract patients and healthcare workers. Moreover, these low priority alarms lead to the same response from healthcare workers as false alarms [7].

- **False alarm rates.** It has been found that 80%-99% of alarms in healthcare are false [8]. This 'cry wolf' leads to healthcare workers ceasing to respond, delaying their response, or actually turning off the alerting system. Therefore, the danger is that a correct detection is ignored.
- **Design of alarm sounds**. Most alarms are fixed tone, beeps and bells that provide limited information, and are annoying to healthcare workers and patients alike [7].

Anaesthetic machine alarm issues

A high fidelity simulation based study was carried out with 10 pairs of trainee anaesthetists. As part of the study, the experimenter switched the oxygen and nitrous oxide pipelines on the anaesthetic machine. The trainees were unaware of this switch in the pipelines. It was found that only 3 out of 10 of the pairs of trainees noticed the transient high nitrous oxide alarm. Although nine of the pairs noticed the low oxygen alarm, it was so loud and distracting that it was muted- perhaps leading the trainees to 'forget' the problem [8].

- **Relationship between alarm sound and function.** The sheer number, variety, and lack of standardisation of alarms in healthcare means it is almost impossible to remember what an alarm is indicating [9]. It is suggested that standardisation of alarms should include: establishing protocols to set patient-specific alarms; documenting alarm parameters in patient records to improve alarm adjustment compliance; agreeing on procedures to pause or silence alarms, removing unnecessary alarms; and establishing standard procedures to ensure safe alarm management and response [10]. However, there is also a need for manufacturers to standardise alarms and follow the requirements of alarm related standards such as IEC 60601 [5].

Device controls

Controls are necessary for humans to be able to interact with machines, and allow healthcare workers to make inputs to a medical device. There are eight principles to consider in the design of controls [1].

1. **Match user expectations**. The controls movement should match what a user expects.

System function	Control Movement
On	Down, right, forward, pull
Off	Up, left, rearward, push
Right	Clockwise, right
Left	Anti-clockwise, left
Up	Up, rearward
Down	Down, forward
Increase	Up, right, forward, clockwise
Decrease	Down, left, rearward, anti-clockwise

It is worth noting that there are differences between countries. For example, in the U.S., on is up, and down is off.

2. **Movement compatibility.** Movement compatibility refers to the relationship between control motions and the movement of display indicators. The movement of a control should match the expectations of people who interact with the control and the display system should also match expectations. So for example, if a healthcare worker wants to turn the flow of a gas down, then the dial should turn in the same way as the indication of the flow- see opposite.
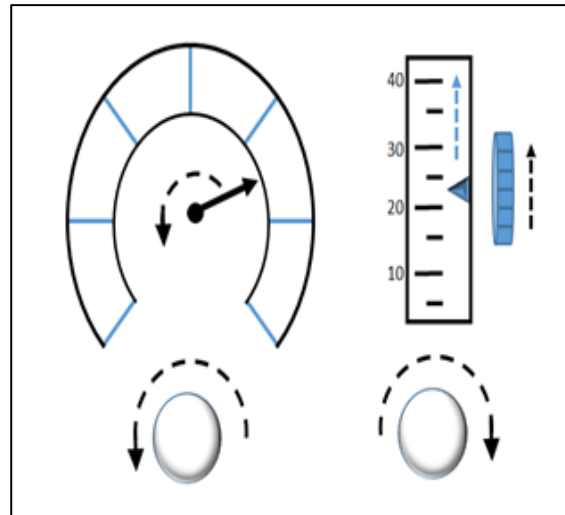
3. **Visible placement.** Controls should be placed where they are visible and accessible. Displays should be placed in close proximity to associated controls. If the position of the control is its own "display," the user must be able to ascertain that the control has been correctly manipulated.

4. **Control coding.** Controls with different functions must not be identical in appearance. The user must be able to distinguish controls quickly and accurately. This can be achieved in a number of ways.
   - **Colour-** Controls can be colour-coded. However, the environment in which the controls are to be used must be considered. Colour-coding should be that with which users are most familiar such as RED for "danger" or "stop," GREEN for "on," YELLOW for "caution".
   - **Arrangement-** Controls that are used together should be grouped. Controls that follow a fixed, sequential order of use should be placed to replicate that order. The most critical and most frequently used controls should be placed in the most visible and accessible positions. Controls should be placed in close and logical proximity to their associated display
   - **Shape-** Useful in an environment in which the user needs to be able to distinguish a control that is not within direct view.

5. **Feedback.** Controls should provide feedback to the user that the desired control state has been achieved. The feedback should come from:

- **Resistance-** indicates when the activation is complete (e.g. in the dial opposite, that 'clicks' into place to give some haptic feedback that a particular number has been selected).
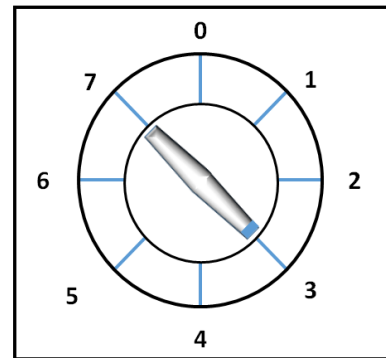
- **Position-** At times, a control is its own 'display.' In the example of the dial provided above, the dial makes it clear it is at position three, so there is no need for another display.
  - **Control panel-** Control panels often have indicator lamps that are illuminated (or not) to show the state.
  - **Computer screen-** If controls are activated by means of keyboard, mouse, or other input device to a computer screen, the state is usually indicated by a corresponding change on the display (e.g. changing colour to indicate that something has been selected).
  - **Timing-** Instantaneous or nearly instantaneous feedback is helpful. If there is a lag of even 100 milliseconds, an unskilled operator will have difficulty.

The following example illustrates a particular problem with control feedback.

Error provoking design

- A doctor sets the oxygen flow control knob to between 1 and 2 litres per minute, not realising that the scale numbers represent discrete, rather than a continuous setting.
- There was no oxygen flow between the settings, yet the knob rotated smoothly, suggesting that intermediate settings were possible.
- The infant patient became hypoxic before the error was discovered.
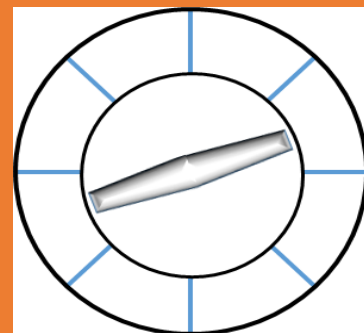
6. **Control-display compatibility**. The degree to which the function and use of a control and its associated display are unambiguous and are immediately apparent to the user. For example, in the picture of a stove top provided opposite, the arrangement on the left does not obey the control-display compatibility, but the one on the right does obey this principle.
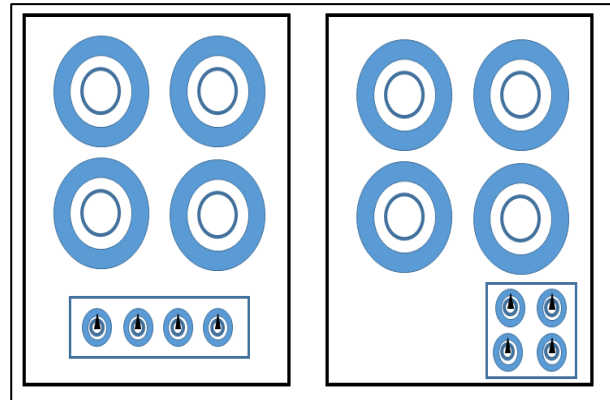
7. **Transfer effects**. Negative transfer occurs when a user's prior experience and/or training conflicts with a new or current control or display design.

8. **Limit number of choices.** The speed with which an action can be selected is strongly influenced by the number of possible alternative actions that could be selected. Hick-Hyman Law of reaction time shows a logarithmic increase in reaction time as the number of possible choices increases.
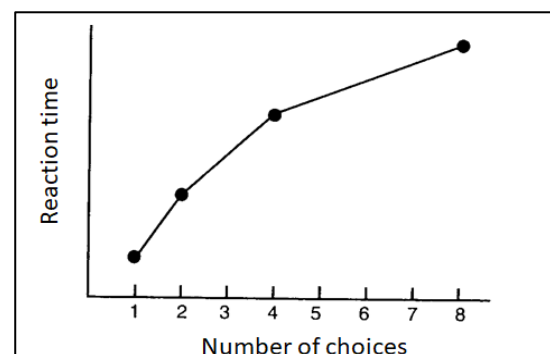
Conclusion

The consideration of ergonomics in design in healthcare has huge implications for reducing fatigue, reducing injury, improving productivity, improving patient safety, and increasing job satisfaction. A greater focus on workplace and device design in healthcare will benefit both patients/service users and healthcare workers. Moreover, following an incident, careful consideration should be given to the potential for design issues to have been a contributing factor.

Practical implications

- Consider the medical devices that you use frequently, what are the ergonomic issues with the device, and could they be mitigated?
- The principles of device design outlined in this chapter should be used to support the evaluation of medical devices when making purchasing decisions.
- Following a safety incident, give consideration as to whether equipment design was a contributory factor.

Online resources

- U.S. Food and Drug Administration (2016). *Applying Human Factors and Usability Engineering to Medical Device*s. See: www.fda.gov/regulatory-information/search-fda-guidance-documents/applying-human-factors-and-usability-engineering-medical-devices.
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Additional readings

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10. Bach, T. A., Berglund, L. M., & Turk, E. (2018). Managing alarm systems for quality and safety in the hospital setting. *BMJ Open Quality*, *7*(3), e000202.

Chapter 4.
Situation awareness and decision making

Introduction

Non-technical skills are the cognitive, personal resource, and social skills and skills that complement a healthcare workers technical ability [1]. Despite the importance of these skills, traditionally they have been developed on the job as opposed to being formally taught. The cognitive skills typically include situation awareness and decision making (covered in this chapter). The personal resource skills include coping with stress and fatigue (covered in chapter 5). The social skills include communication (addressed in chapter 6), teamwork and leadership (covered in chapter 7).

Why should I read this chapter?

A consideration of how information is gathered, and decisions are made, will help health care workers to avoid cognitive traps. This chapter will provide a model of situation awareness, and discuss how situation awareness can be maintained (and lost). Good situation awareness leads to good decision making and four different decision making strategies, and their relevance to healthcare workers, are discussed.

Situation awareness

Situation awareness is an understanding of what is going on in a particular situation, or with a particular patient/service user. Put simply, situation awareness is how accurately your perception of the current environment matches reality. A similar, but more detailed definition is "*the detection of elements in the environment, the comprehension of their meaning, and the projection of their status in the near future*" [2]. This definition identifies three distinct levels of situation awareness.

Level 1: Perception of the elements in the current situation. Noticing the individual elements (or cues) within the current situation- e.g., high respiratory rate, high heart rate, high temperature, altered mental state.

Level 2: Comprehension of current situation. Processing the incoming information (gathered in Level 1) in order to understand what is happening now, and build an accurate mental model of the situation- e.g. the patient is septic.

Level 3: Projection of future status. Using the current information and understanding to predict what will happen in the future- e.g., the need to commence sepsis six, look for signs of organ dysfunction, look for signs of septic shock.
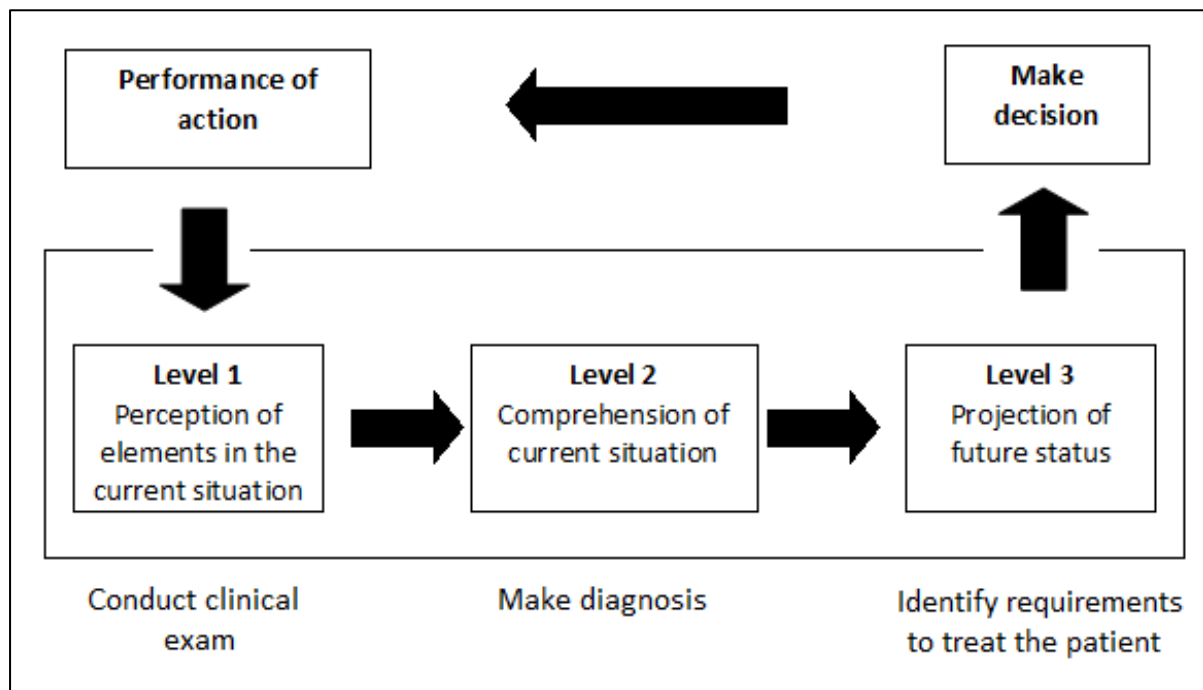
When experts make errors in situation awareness, they are most frequently made in level one (perception of the elements in the current situation). Errors at this first level can be due to the unavailability of data, data that are difficult to perceive, failure to scan for or observe data, misperceiving data, or focusing on one piece of data to the exclusion of other information. Experts can be susceptible to such perception errors because their experience leads them to see what they expect to see (confirmation bias), close out the search too early (premature closure) or not seek disconfirming information (over-confidence). Once the healthcare worker has an accurate perception of the situation, experts are usually good at understanding the situation, and projecting forward to what is likely to happen next and importantly, what should be done next. Novices tend to make different mistakes than experts. Novices find it difficult to perceive cues in the situation because they may not know what to look for and their lack of rich mental models means that they are less skilled in interpretation and projection into the future.

Situation awareness is an individual skill. However, when information is dispersed across the members of a team, or when the task requires input from several team members (e.g. resuscitation) there is a need for a shared understanding- or team mental model. Team mental models are discussed in more

detail in the teamwork chapter (Chapter 6). Situation awareness is a critical skill for all healthcare workers because it is required for timely communication, accurate decision making and appropriate leadership [1]. The example below shows the gradual deterioration of Savita Halappanavar following her presentation with a miscarriage to Galway University Hospital in October 2012 [3,4]. It demonstrates how it can be very easy to miss the changes in the status of a gradually deteriorating patient.

The contribution of change blindness in the death of Savita Halappanavar [3,4]

On the morning of 21 October 2012, Ms. Hallappanavar presented at Galway University hospital after suffering from 12 hours of back pain. Ms. Hallappanavar was 17 weeks pregnant. At this time the foetal heart rate was present, and she was discharged and it was recommended that she should take paracetamol. Ms. Hallappanavar re-attended the ward in the afternoon as she had a sensation of 'coming down'. She was examined, and it was determined that a miscarriage was inevitable, and Ms. Halappanavar was admitted.

The following day (22 October) early indicators of possible sepsis were present. That evening Ms. Halappanavar was found to have a heart rate of 102 beats per minute and blood pressure of 98/62 mmHg. Shortly after midnight, her membranes spontaneously ruptured. Her condition then gradually deteriorated over the next 36 hours. However, sepsis was not diagnosed. On the evening of 24 October, the staff recognised that Ms. Hallappanavar was severely septic, and more aggressive treatment and closer monitoring commenced. Unfortunately, this treatment was unsuccessful and Ms. Hallappanavar died in the early morning of the 28 October 2012. This case demonstrates the challenges in identifying a gradually deteriorating patient.

Clues that situational awareness has been lost

There are common 'clues' that can signal that you, or a member of your team, is 'losing' situation awareness [1].

- Ambiguity- information from two or more sources does not agree (e.g. no rise in oxygen saturation despite the patient being placed on 100% oxygen).
- Fixation- focusing on one thing to the exclusion of everything else.
- Confusion- uncertainty or bafflement about a situation (often accompanied by anxiety).
- Lack of required information.
- Failure to maintain critical tasks (e.g. monitor patient vital signs).
- Failure to meet an expected target.
- Failure to resolve discrepancies (e.g. contradictory data, personal conflicts).
- A 'gut' feeling that things are not quite right.

Maintaining good situation awareness

There are several ways that healthcare workers can take active steps to maintain their situation awareness or regain it once it has been lost.

1. **Get the right information**
   - Consider all of the information.
   - Make extra efforts to get information during abnormal situations.
   - After an interruption or distraction, back up several steps from where you think you left off, or double check all steps.
   - Be aware of environmental effects (e.g. noise, distractions).
   - Practice good handover techniques.

2. **Overview**
   - Stand back and look at the problem.
   - Double-check assumptions.
   - Check assumptions with others.
   - Stay focused on the goal, but avoid tunnel vision.
   - Take time out and review objectively.
   - Verbalise decisions.

3. **Review**
   - When possible, discuss how a particular situation was resolved identifying both good and bad points.

Early warning score systems, such as the National early warning system (NEWS), are valuable tools to help healthcare workers to recognise a deteriorating patient [5]. These systems support each of the three levels of situation awareness by directing healthcare workers to the parameters that should be examined. They then allow an assessment to be made as to whether a patient is deteriorating and whether action needs to be taken (i.e. escalating the patient to the next level of care).

Questions to calibrate situational awareness

It is suggested that periodically, during a dynamic and fast moving event, you ask the following questions of yourself [1].
- What is the immediate goal of you/your team?
- What are you doing to support that goal?
- What are your concerns?
- What do you think this situation will look like in ___ minutes, and why?

Decision making

The ultimate goal of situation awareness is to support effective decision making. There is no one decision making strategy that works in every situation [6]. Moreover, in dynamic areas of healthcare, problems are often ill-defined, with no single 'best' solution. The naturalistic decision making framework is an approach to considering how people make decisions in demanding, real-world environments- including healthcare [7,8]. This framework identifies of four decision making strategies that are used by people in real world environments:

1. recognition-primed (intuitive);
2. rule-based;
3. rational choice; and
4. creative.

Recognition-primed (intuitive) decision making

Intuitive or recognition-primed decision making is an approach that can be appropriate in high-workload, and time-limited situations. It is how experienced people make decisions rapidly. This decision making strategy is sometimes called 'gut-feel' [9]. Essentially, decision makers use their experience to recognise the situation and identify actions without comparing options. Cues in the situation or environment allow them to recognise patterns from which they can judge the typicality of the situation. They can then quickly identify an appropriate action. Expert decision makers will test their actions using mental simulation to play the situation forward, in their mind. If the action seems to work they will choose the action, if the action seems to be flawed, they will select and 'test' another action using mental simulation.

Research that was instrumental to the development of the naturalistic decision making framework by Dr. Beth Crandall and colleagues was a study of decision making by neo-natal intensive care nurses [10,11]. It was found that some nurses were able to tell when a baby was just beginning to become septic, and could alert the health care team so that early intervention could save the baby's life. Sometimes, if the nurses waited for the results of diagnostic tests, it may be too late. However, these nurses used cues such as skin tone, muscle tone, and alertness to develop a mental model that gave them a workable result, i.e. the ability to recognise the early onset of a deadly infection. Recognition primed decision making is characterised by:

- actions and reactions are based on past experience;
- the emphasis is on reading the situation, rather than on generating different options for possible actions;
- experienced reading of a situation, so that the selection of a course of action is obvious; and
- the generation of a solution that, should result in a workable solution.

Positives	Negatives
• A useful method when time is limited.	• Can only be applied in certain situations.
• Requires little mental effort.	• The decision maker must be an expert.
• Can provide a satisfactory, workable plan.	• Encourages confirmation bias- i.e. only for evidence to support one's mental model, rather than considering evidence that may not support that model.
• Is useful in routine situations	

Rule-based decision making

Rule-based decision making, such as the use of protocols or procedures, is a common approach to decision making in healthcare. This decision making technique can be used to solve familiar problems for which solutions are governed by written rules or procedures. Once the problem has been diagnosed, you need only identify the correct rule or guideline and follow it. Although preferable, you do not necessarily need to be an expert or even understand the rationale behind every step to use this decision making strategy. A good example of rule based decision making is the NEWS (and other early warning score systems) widely used in Irish Hospitals. If a patient's EWS score reaches a certain parameter this triggers a predetermined course of action [5].

Positives	Negatives
• The decision maker does not need to be an expert.	• It is easy to miss a step in the sequence.
• The decision maker does not need to understand the purpose of every step.	• If the diagnosis is incorrect, the wrong rules are being followed.

Rational choice decision making

This technique usually produces the best solution, and it is most valuable in solving new problems. However, it is slow, laborious, and affected by stress and fatigue. This decision making method may involve thinking of a number of solutions, and then deciding which would affect the best outcome. A prime example of rational choice decision making is the multi-disciplinary team meeting in which specialists from relevant specialties discuss treatment options for complex patients. We know however, that inconsistency is a major weakness of this type of decision making. When presented with the same case information on separate occasions, decision makers often reach different conclusions [6]. The four steps in using this method include:

1. Identifying the problem.
2. Generating a set of options for solving the problem.
3. Using a number of strategies (e.g., comparing the relevant features of the options) to evaluate the options concurrently.
4. Choosing and implementing the preferred option.

Positives	Negatives
• Normally produces the best solution. • Useful when trying to solve a novel problem.	• Slow. • Laborious. • Negatively affected by stress and fatigue. • If crucial information is missing the comparison will be biased.

Creative decision making

This method is infrequently used in high time pressure environments, as it requires devising a novel course of action for an unfamiliar problem or situation. This decision making strategy is (fortunately) not common in healthcare. An example of this strategy in practice is the use of a range of different treatment protocols and drug therapies by ICU teams, at the beginning of the COVID-19 pandemic.

Positive	Negative
• Results in a solution for an unfamiliar problem.	• Time consuming. • The solution is untested. • Difficult in noisy and distracting envronments. • May be difficult to justify. • Negatively affected by stress and fatigue.

Factors influencing decision making

Competence in decision making is influenced by technical expertise, level of experience, and familiarity with the situation. Of the four types of decision making described above, stress and fatigue have the most impact on choice and creative approaches to decision making. This is because these two methods require considerable cognitive resources to complete. In contrast, intuitive decision methods take minimal thought, and so stress or fatigue have little impact. Similarly, if rules or protocols are easily located, then this approach to decision making will also generally function well in stressful conditions.

Increasing cognitive effort
Increasingly affected by stress and fatigue

Creative   Choice   Rule-based   Intuitive

Decreasing cognitive effort
Decreasingly affected by stress and fatigue
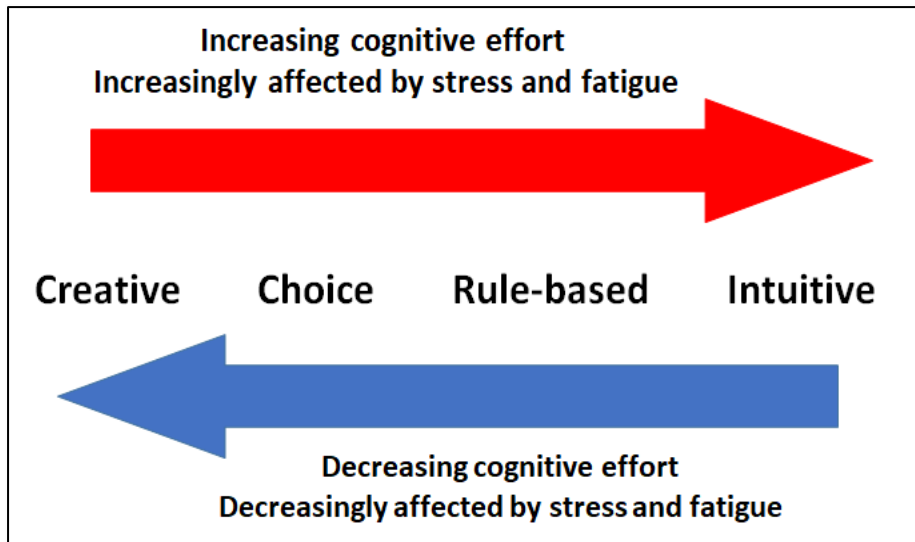
Why is understanding decision strategies important

Understanding our decision strategies (academics call this metacognition) allows healthcare workers to reflect on the decision strategies they are using. Considering decision making strategies also helps those who write procedures and protocols to ensure that the procedures support, rather than hinder, healthcare workers to make decisions.

Conclusions

Situation awareness and decision making are crucial to the delivery of safe and effective patient care. The models of situation awareness and decision making presented in this chapter can help healthcare professionals consider the process of decision making and critically reflect on when decision making has been both effective and ineffective.

Practical applications

- Look out for clues that situation awareness has been lost by your team members.
- Apply the approaches for maintaining situation awareness in your work.
- Consider applying the questions to calibrate situation awareness in dynamic situations.
- Most errors in situation awareness occur in gathering information.
- When making decisions, or reflecting on the decisions you have made, consider the style that was used and the appropriateness of that style, based on the time and level of risk.
- Practice good handover processes.
- Minimise interruptions and distractions during critical tasks.

Online resources

Situation awareness
- Dr. Mica Endlsey describes situation awareness for healthcare. See: youtu.be/0WaGolF2V2c
- Martin Bromley talks about his experience of losing his wife during an apparently routine procedure that can be attributed to failures of situation awareness and decision making under stress. See: youtu.be/JzlvgtPIof4.
- Early warning score system: See: www.hse.ie/eng/about/who/cspd/ncps/acute-medicine/national-early-warning-score/
- Seeing the world as it isn't. See: www.youtube.com/watch?v=9Il_D3Xt9W0

Decision making
- Dr. Gary Klein describing problem detection. See: youtu.be/UXx51qK4ItQ
- Naturalistic decision making. See: naturalisticdecisionmaking.org/

Additional readings

- Biswas, A. (2015). Gut feeling: does it have a place in modern physician's toolkit? *Medical Teacher* 37, 309-311. doi.org/10.3109/0142159X.2014.960378.
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Chapter 5.
Stress and fatigue

Introduction

High levels of stress and fatigue have a negative impact on both individual and team performance. Stress and fatigue are commonplace in healthcare but, the impact on performance is often under-estimated. Therefore, a consideration of stress and fatigue is important when contemplating how to optimise the performance of healthcare workers.

Why should I read this chapter?

This chapter will discuss stress and fatigue, their impact on performance, and consider how to minimise their effects. Healthcare workers should read this chapter because stress and fatigue are widespread within healthcare organisations and an improved understanding of these phenomena will help to minimise the impact on the well-being of healthcare workers and patients/service users.

Stress and performance

Stress is the adverse reaction people have to excessive demand placed upon them [1]. It is important to indicate that it is an individual's *perception* of the demands and their perceived capability to meet these demands that is important. As such, not everyone will experience the same level of stress in the same situation. Within the context of work-related stress, distinguishing between chronic and acute stress is important. Chronic stress is related to conditions in the workplace and the individual's reaction to these conditions over a protracted time. In contrast, acute stress is sudden, novel, intense, and relatively short in duration.

Chronic stress

High level of chronic stress has been identified as being an endemic problem for healthcare workers. Survey research identifies that upwards of a third of healthcare workers are suffering from high levels of chronic stress. The relationship between the stress response and performance is typically depicted as an inverted "U" curve. Initially, performance improves with increases in stress to an optimal range where performance peaks. However, with further increases in demands beyond this peak, performance decreases. The stress-performance curve is not the same for every individual. Some people have lower tolerances to stress- and even for one person it may vary from day to day.
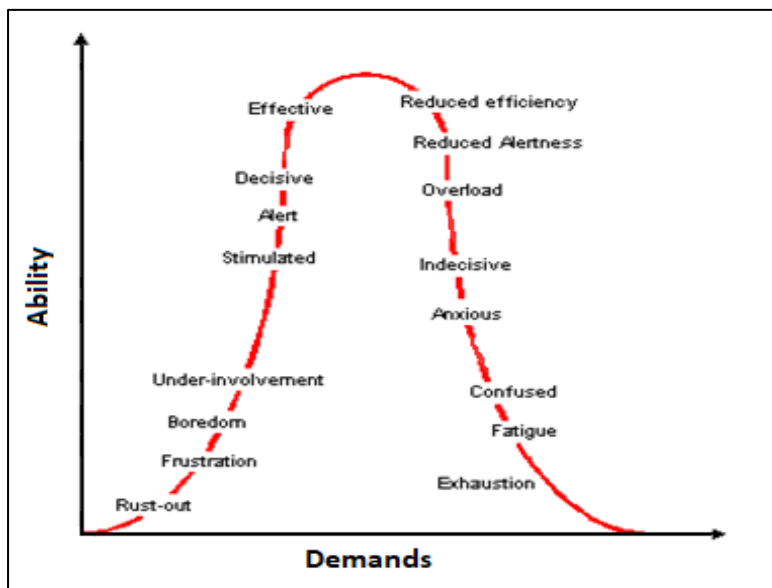
No single method exists to identify whether someone is suffering from chronic stress. Many people may not wish to admit to themselves, let alone to others, that they are effected by stress. Indicators of chronic stress can be divided into four categories [2].

Behavioural	
• Apathy. • Reduced productivity. • Absenteeism.	• Drug use (e.g., increased alcohol use or smoking). • Hostile behaviour. • Compassion fatigue.

Emotional	
• Expressions of anxiety and hopelessness • Irritability.	• Appearance of boredom or apathy. • Cynicism and resentfulness.

Somatic (physical)	
• Health complaints such as headaches, chest pains, or stomach complaints. • Decline in physical appearance.	• Chronic fatigue. • Frequent infections.

Thinking (cognitive)	
• Impaired decision making.	• Lack of concentration.

Once symptoms of stress are present, they can result in decreased performance for both an individual and a team. Even if one member of a team is suffering from chronic stress, productivity can be reduced and the likelihood of errors can increase. Of particular relevance to healthcare workers, chronic stress and physical and mental exhaustion can lead to compassion fatigue. Compassion fatigue can be defined as state of exhaustion and dysfunction biologically, psychologically, and socially as a result of prolonged exposure to compassion stress [3]. It is characterised by a lack of capacity to empathise or feel compassion for others.

Managing chronic stress

Chronic stress can be addressed by either focusing on the individual, or focusing on the organisation. There is a tendency within healthcare for stress reduction interventions to focus on making the individual more stress tolerant. Typical stress management techniques include:

- **Muscle relaxation**- this involves tensing (for 5 to 10 seconds) and releasing one muscle group at a time in a specific order, generally starting with the lower extremities and finishing with muscles of the face, abdomen, and chest.
- **Meditation**- the purpose of this is to quiet the mind, emotions, and body.
- **Biofeedback**- this is a training technique in which an individual learns to control the physiological reactions (e.g., increased heart rate and muscle tension) to stress.
- **Cognitive-behavioural stress management**- this involves changing the way the individual thinks about stress. The aim is to help him or her to recognise negative or inaccurate thoughts and to alter the behavioural responses to these thoughts.

Although there are certainly benefits of individual focused techniques, the most effective approaches to managing stress are likely to be those focused on reducing stressors that exist at an organisational level such as high workload, inefficiency, and lack of resources. Obviously, certain stressors (e.g. shift work, emergencies) are part of the job of a healthcare worker and cannot be changed. However, other stressors, such as staff shortages or lack of resources, may be possible to change. Those in senior positions are likely to have some power and influence to address these chronic stressors. Bullying is a serious and sadly common occurrence in healthcare environments. Most healthcare organisations have a bullying policy and healthcare workers should be aware of it. Addressing these organisational level stressors is likely to have a longer lasting and more sustained impact on chronic stress than individual level interventions. The UK Health and Safety Executive [1] (listed below under further reading) provide an approach for addressing stress at an organisational level.

Acute stress

Healthcare workers are at risk not only from chronic stressors but also from acute stressors such as periods of high workload or emergencies. The indicators of acute stress include [2]:

Behavioural	
Fight/flight:	Freezing:
• Hyperactivity.	• Withdrawn ("switched off").
• Anger.	• Detachment.
• Argumentative.	• Apathy.
• Irritability.	• Disengagement.
• Aggressiveness.	
• Emotional outbursts.	

Emotional	
• Fear.	• Fear of failure.
• Anxiety.	• Vulnerability.
• Panic.	• Loss of control.

Somatic (physical)	
• Energy surge.	• Muscle tension (shaking).
• Increasing heart rate.	• Heightened sensitivity (e.g., to noise).
• Sweating.	• Effects on digestion (butterflies in stomach).

Thinking (cognitive)	
Impairment of memory.	• Prone to distraction.
	• Confirmation bias- tending to ignore information that does not support following a chosen model or course of action.
	• Information overload.
	• Task shedding- the abandonment of certain tasks when stress or workload makes it difficult to concentrate on all of the tasks simultaneously.
Reduced concentration.	• Difficulty prioritising.
	• Preoccupation with trivia.
	• Attention becoming narrowly focused on obvious cues.
Difficulty in decision making.	• Availability bias- resorting to familiar routines and considering plans that are only immediately available in memory.
	• "Stalling thinking"- mind blank.

Managing acute stress

1. **Use a procedure to regulate stress reactions**.
   - **Stop**- Stressed personnel should stop what they are doing.
   - **Breathe**- They should focus on slowing their breathing rate, and calming down.
   - **Think**- They should think about the problem and decide what they are going to do next.
   - **Act**- They should select an option and, finally, act on it.

2. **Practice using cognitive control techniques**. This technique trains individuals to regulate emotions (e.g., worry) and distracting thoughts so that they maintain concentration on the task. They can become aware of what their bodies are telling them. If their muscles are very tense or their hearts are racing, they can attempt to regain control of them by briefly stepping away from a situation, if they feel overwhelmed.

3. **Debrief the team after a stressful event**. Debriefing has been shown to be a highly effective strategy to help team members to develop skills and understanding. Debriefing allows team members to discuss what has happened, both good and bad, and to realise that it is normal to experience stress in such situations. Further, if people are placed in a stressful situation and do not perform well, they are unlikely to cope well when faced with another stressful situation; unless they are given a thorough debriefing about what went wrong, why it went wrong, and what they can do to avoid the same mistakes in the future.

4. **Practice performing in simulated stressful scenarios.** The only way to see how healthcare workers will cope with stress is to put them into a stressful situation. The best way to improve performance in stressful situations is to conduct simulations in which individuals are forced to react quickly and think on their feet. This is particularly important for high risk/low frequency events [2].

Fatigue

Fatigue can be defined as the state of tiredness that is associated with long hours of work, prolonged periods without sleep, or requirements to work at times that are "out of sync" with the body's biological or circadian rhythm. Although attitudes are changing, healthcare workers tend to under-estimate the impact of fatigue on performance. The causes of fatigue include the obvious one of long hours of work as well as a lack of sleep. However, factors such as stress, temperature extremes, noise (>80 dB), and physical work are all fatiguing.

Circadian rhythm

The circadian rhythm is a name given to the "internal body clock" that regulates the approximately 24-hour cycle of biological processes in animals and plants. In a typical circadian cycle, performance peaks between 1200 and 2100 (usually around 1600) and falls to a minimum between 0300 and 0600 hours.
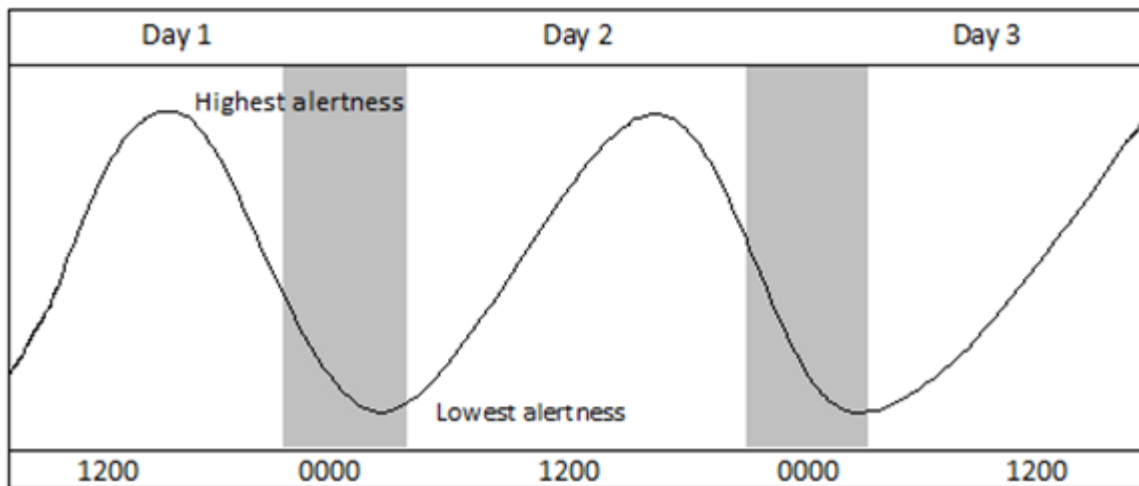
Evidence from traffic accidents and occupational accidents shows that a peak tends to occur in the early hours of the morning, when performance is at its lowest. It takes about seven cycles (during which the circadian rhythm is desynchronized) to adjust from working during the day to working during the night. Therefore, a single period of night work is much better tolerated than three or four consecutive periods of night work.

Effects of fatigue

As is the case with stress, fatigue has a range of effects [2].

Thinking (cognitive)
- Adverse effect on innovative thinking and flexible decision making.
- Reduced ability to cope with unforeseen rapid changes.
- Less able to adjust plans when new information becomes available.
- Tendency to adopt more rigid thinking and previous solutions.

Motor skills
- Less coordination.
- Poor timing.

Communication
- Difficulty in finding and delivering the correct word.
- Speech is less expressive.

Social
- Become withdrawn.
- More acceptance of own errors.
- Less tolerant of others.
- Neglect smaller tasks.
- Less likely to converse.
- Increasingly irritable.
- Increasingly distracted by discomfort.

The effects of fatigue can also be compared to the effects of alcohol consumption [4].

Sleep Loss (hours)	Equivalent standard drinks
8	10–11
6	7–8
4	5–6
2	2–3

Shift work

Shift work is a major contributor to fatigue for healthcare workers. A study of shift working nurses found that providing them with control over shift work scheduling, break opportunities at work, being younger, and being part of a family structure were associated with improved recovery from shift work induced fatigue [5]. However, although it is possible to reduce the negative impact of shift work on night time sleepiness and daytime insomnia, there is no way to eliminate many of the negative effects of shift work [6]. Costa et al. [7] provide the following recommendation for organising shift schedules.

- The amount of night work, and the number of consecutive night shifts should be minimised.
- A quick rotating shift schedule is preferable to a slow rotating schedule.
- A forward shift rotation (morning to evening to night) results in less fatigue than a reverse rotation (night to evening to morning).
- Morning shift should not start too early, and evening shift should not end too late, and night shift should end as early as possible).
- Long shifts (9 to 12 hours) should only be used when the workload is suitable, breaks can be taken, and the shift schedule is designed to minimise the excessive accumulation of fatigue.
- Shift cycles should be regular and ensure as many weekends as possible are kept free from work.
- Fixed night shifts should only exist where a complete adjustment to night shift is necessary to ensure patient safety.
- Flexible working time arrangements should be promoted.

Clearly, it is not possible to follow all these recommendations, and any shift schedule is a compromise. However, what is most important is that shift workers participate in the analysis, design, and implementation of a shift working schedule.

Managing fatigue

- **Sleep** is the most effective measure for reducing fatigue.
- **Napping** is also effective in reducing fatigue. Even a short nap of 10 minutes can improve functioning. However, longer naps can have a hangover effect in which the individual may be sluggish or confused for about five minutes after waking up.

- Fatigue is an aspect of operations that should be **considered and managed during planning**. Where possible, intricate or risky activities should be avoided between 0300 and 0600.
- **Caffeine** can be as effective as other medical stimulants in maintaining performance when you are fatigued. Caffeine is most effective for people who do not normally consume large quantities on a daily basis. One <u>small</u> cup is recommended for consumption every two hours up to five hours before the next sleep break.
- **Monitor** team members for signs of fatigue [2].

Conclusion

No one is immune to the effects of stress and fatigue. However, there are measures at both an individual, and more importantly, organisational level that can minimise the impact of stress and fatigue on the well-being of healthcare workers, and benefit patient safety and quality of care.

Practical applications

- Be aware of the effects of stress and fatigue on your own performance, as well as the performance of other members of your team.
- Consider how to minimise the impact of stress and fatigue in your life.
- Those in leadership positions should consider how stress and fatigue could be better managed at an organisational level.
- Consider the shift structure and whether it can be redesigned to reduce the impact of fatigue.

Online resources

Stress
- HSE Health and well-being. See: www.hse.ie/eng/about/who/healthwellbeing/
- Health and Safety Authority, work related stress and well-being. See: www.hsa.ie/eng/Your_Industry/Healthcare_Sector/Work_Related_Stress/.

Fatigue
- National sleep foundation has lots of information on sleep, fatigue, and shift work. See: www.sleepfoundation.org.

Additional readings

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Chapter 6.
Team Communication

Introduction

Communication is the exchange of information, feedback or response, ideas, and feelings [1]. The ability to exchange information and co-ordinate actions is one factor that differentiates between good and poor team performance. Errors in communication can occur if individuals fail to pass on information, or communicate incorrect information.

The exchange of information is a core activity for decision making, situation awareness, team co-ordination, and leadership. Effective communication enhances information-sharing, perspective-taking, and genuine understanding. The importance of communication for effective performance, reducing errors and improving safety cannot be over-emphasised. The incident described below shows the impact that poor communication can have on patient care.

Breakdown in communication: Kevin's story (adapted from [2])
Kevin was initially seen by his GP in 1997- a year and 10 months before he died. During that year, 19-year-old Kevin presented to his GP on a number of occasions with persistent back pain. Without any improvement, he was referred to an orthopaedic consultant. Blood tests revealed high levels of calcium (3.51mmol/l). This level of calcium causes serious damage to health and is most commonly an indication of primary hyperparathyroidism or a malignancy. Other parameters were also raised. All of these abnormal results were underlined in the laboratory report. When the orthopaedic consultant wrote to Kevin's GP he noted his intention to see him again early in the new year, but underplayed the high calcium levels and ignored a plasma creatinine level indicative of more than 50% loss of overall renal function. That letter is not on the GP's file, and the consultant's intention to see him again was not conveyed to Kevin.

Over the following months, Kevin continued to attend his GP, as well as a physiotherapist and other services. However, his condition was not diagnosed. Kevin spent the summer of 1999 in the U.S., and on his return to Ireland attended his GP complaining of lethargy, occasional vomiting, and continuing bone pain. Blood and urine samples were taken, with the test results telephoned to the GP surgery the next day. The results were written on a Post-It note by the practice nurse, who drew attention to the high calcium level (now at 5.73mmol/l). However, the GP did not mention this in his letter of referral to the hospital, focusing only on those elements of the blood test results that supported his own diagnosis of leptospirosis. However, he did send the Post-it note with the letter.

When compiling the file in the hospital, the Post-It note containing the crucial calcium results was found stuck to the back of the GP's referral letter and was not seen until six weeks after Kevin's death. The standard blood test in that particular hospital did not include testing for calcium levels. Therefore, throughout Kevin's time in hospital, his care team remained unaware of his dangerously high calcium levels, and a diagnosis of nephritis was made.

Finally, Kevin was transferred to a tertiary hospital and it was there that his family first heard concern over calcium levels of 6.1m.mol/l. Kevin's care was left to be managed at Registrar level – senior personnel were not alerted and more aggressive treatments were not available at the weekend. On the Sunday afternoon, Kevin suffered a myocardial infarction. His cause of death listed multi-organ failure, hypercalcaemia, and parathyroid tumour.

Why should I read this chapter?

This chapter will cover models of communication, and techniques for effective communication including assertiveness, active listening, and structured handovers. Healthcare workers should read this chapter because communication is fundamental to the delivery of safe and effective care across the health service.

Models of communication

Communication is typically described as either one-way or two-way. One-way communication appears simple. The information, or message, that the sender wants to convey is encoded into words or other signals by the sender that are then transmitted to one or more receivers, who then decode the information to identify the meaning.

Model of one-way communication
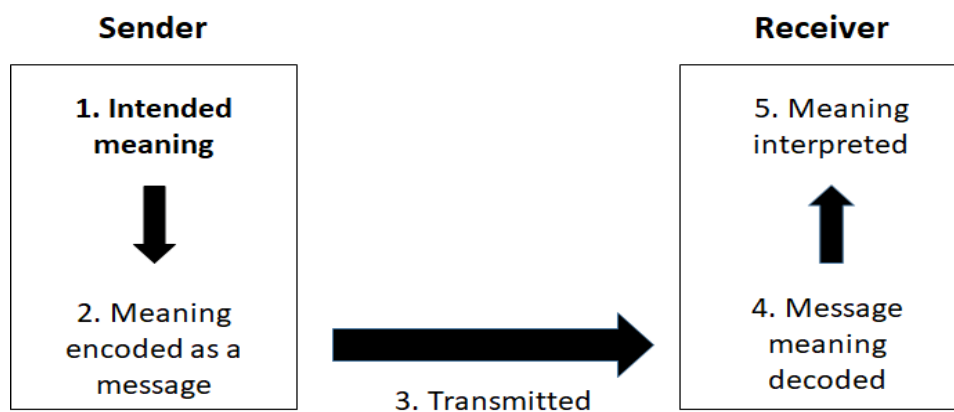
One-way communication includes spoken, written, email, text message, pager message, or voicemail. There are certain advantages and disadvantages to one-way communication- as shown below [1]. An example of one-way communication are notes in a patient record.

Advantages	Disadvantages
• Fast.	• Requires planning to do well.
• Looks and sounds 'neat'.	• All responsibility for the message lies with the sender.
• The sender is in control.	• No feedback.
	• The receiver may not pay adequate attention or tune out.

In two-way communication, the sender transmits information to the receiver who has the opportunity to respond. The receiver then becomes the sender and transmits information back to the receiver, forming a closed feedback loop.

Model of two-way communication
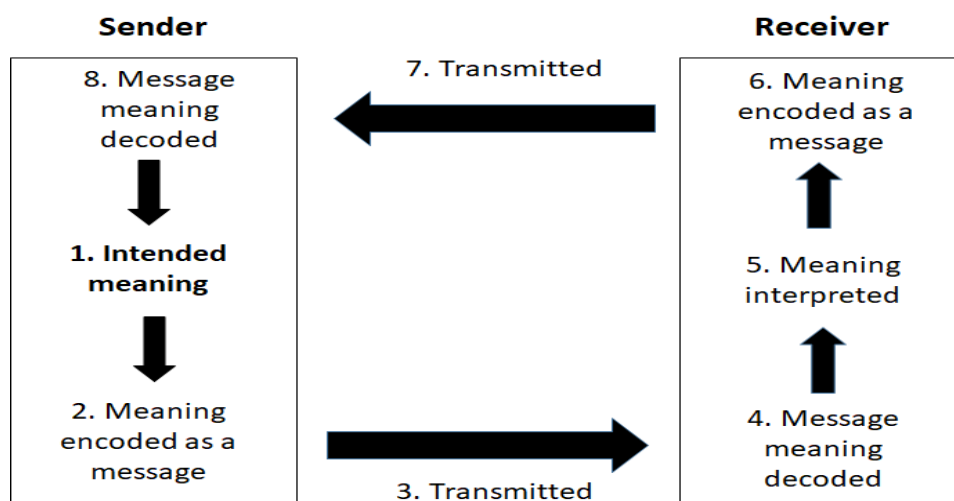
Two-way communication occurs during conversations, telephone calls, emails, or other exchanges where information flows back and forwards between senders and receivers. The advantages and disadvantages of two-way communication as compared to one-way communication, are shown below [1]. An example of two-way communication is face-to-face handover where both the incoming and outgoing teams are present and there is opportunity for questions and clarifications.

Advantages	Disadvantages
• Potentially, more accurate, reliable and effective. • Permits the correction of details. • Requires less planning. • Receivers have more confidence, in the accuracy of the message. • Sender and receiver have responsibility. • Sender and receiver work together to achieve mutual understanding.	• Generally takes longer. • Receiver also has to communicate in return.

Although one-way communication is faster and hence seems more efficient, two-way communication is more accurate because it relies on both the sender and receiver working together to ensure that the communication achieves its objective. Effective communication should be:

- **Explicit**- clearly stating the desired action and who should do it.
- **Direct**- there is a degree of pressure to comply with the desired action.
- **Socially appropriate**- there is sensitivity to the roles and status of the sender, and to the seriousness of the situation.

Brindley and Reynolds [3] provide an excellent overview of communication techniques that have broad applicability to all aspects of communication in healthcare. The strategies identified can be grouped into those that foster clear communication in time critical situations and those that improve assertiveness.

Flying by voice- 'saying out loud' what you are thinking or doing, e.g. '*the patient is not responding, is there anything we are missing?*'

- **Combating mitigating language**- the use of clear and direct language, e.g. '*call anaesthetics now*.'
- **Closed-loop communication**- using two-way communication, e.g. '*call the anaesthetist now, and let me know what she recommends*.'
- **Step-back method**- verbally forcing a 'time-out' to reflect, e.g. '*everyone step back while I re-assess the patient*.'

- **Below ten thousand feet**- minimise any unnecessary conversation during critical tasks (i.e. in aviation below 10,000 feet represents landing or take-off), e.g. recognising the paramedic is performing an intubation, and waiting until s/he is finished before asking a question.
- **Repeat-back method**- repeating back a request to confirm mutual understanding *'I understand, 3 mg of adrenaline'*.

Assertiveness

Assertiveness, or speaking up, can be defined as an upward voice directed from lower to higher status individuals within and across teams, which challenges the status quo, to avert or mitigate errors [4]. Failure to speak up has been identified as negatively impacting patient safety and quality of care, with junior healthcare workers often reporting discomfort 'speaking up' to seniors [5].

Brindley and Reynolds [3] present a number of techniques designed to aid assertive communication. Graded assertiveness provides a way for healthcare professionals to identify how assertive they are being, and how their level of assertiveness could be escalated. They provide six levels of assertiveness:

1. Hint: "*Should things look like this*?"
2. Preference: "*I think it would be wise to …*"
3. Query: "*What do you think we should do?*"
4. Shared suggestion: "*You and I should…*"
5. Statement: "*We need to do the following…*"
6. Command: "*Do it now.*"

The five-step advocacy approach focuses on advocacy and confirmation in order to get a piece of information across [3]:

1. Attention getter: "*The patient is deteriorating".*
2. State your concern: "*The oxygen sats are dropping and the patient is tachycardic".*
3. State the problem as you see it: "*I think the patient has a PE* [pulmonary embolism]".
4. State a solution: "*We need to put the patient on 100% oxygen, and get an IV in now".*
5. Obtain agreement: "*Do you agree?"*

It is important to attend to both verbal and nonverbal cues when you adopt an assertive stance [2].

Verbal	Nonverbal
Content: • Decide what you want to say and state it specifically and directly. Be honest: • Stick to the statement; repeat it, if necessary. • Use "I" statements. • Assertively deflect any responses from the other person that may undermine you. "Broken record technique": • "I hear what you are saying, but..." • Offer a solution. • Obtain feedback.	• Eye contact. • Body posture. • Gestures. • Facial expression. • Voice tone, inflection, and volume. • Timing.

Active listening

In addition to creating a culture that encourages speaking up, there is also a need to encourage active listening – particularly when communicating with patients/service users, families, carers and advocates. Even in ideal circumstances only a small part of what is heard is actually listened to (usually only about one third)[6]. The earlier part of a communication tends to be listened to more than the later- when the listener may be trying to find a place to interrupt. This is described as 'gap searching'. Therefore, it is important that the listener is engaged in the communication process. Below are suggestion of dos and don'ts that will aid in effective listening [1].

Do	Don't
• Be patient. • Ask questions. • Be supportive. • Paraphrase. • Make eye contact. • Use positive body language.	• Debate what is being said in your mind. • Detour (i.e., look for a key word to change the subject). • Finish the other person's sentence. • Pre-plan (work out what the person will say next). • Tune out.

Active listening can be encouraged through techniques such briefings, time-outs, checklists, and standardised handovers.

Handover

The goal of a handover is to ensure continuity of patient/service user care between different teams. However, if the incorrect information is passed over, or crucial pieces of information are missing, this can negatively impact care- as in the prison handover example provided below. Handover should be conducted in-person, utilise two way communication, and active listening. It is recommended that a structured approach to handover, such as ISBAR$_3$ [7], should be used.

- **Identify**: you, your role, the recipient of handover information, the patient.
- **Situation**: a brief summary of patient's current status- what is happening?
- **Background**: what is the clinical background/context?
- **Assessment**: what do you think the problem is?
- **Recommendation**: What do you recommend?
- **Read-back**: check back for shared understanding. Assign and accept responsibility/accountability.
- **Risk**: identify any risks.

Breakdown of communication during a prison transfer (adapted from [8])

Martin, a 43-year-old man, was being held in a prison in the UK. Martin had epilepsy for most of his life, and took anti-epilepsy medicine (Tegretol 400mg prolonged release) twice a day along with a number of other medications to treat a number of conditions. The decision was made to transfer Martin to another prison. After he was transferred, Martin was assessed by a nurse in the prison healthcare department. The nurse noted in Martin's electronic health record that he had been transferred without any medication. The nurse sent a message to the prison doctor via the prison's computerised healthcare system, which said, 'please could you prescribe all this mans [sic] meds – not arrived with any meds – we will arrange a delivery tomorrow.' However, the prison's doctor was absent and there was no one else available at the prison who could prescribe the medication.

That evening (Friday) another doctor, who was covering the prison remotely, electronically prescribed Martin's medication. However, the prescription for epilepsy medication was omitted. This was noticed by the nurse the next day, who then sent another message via the computerised system to the doctor asking for the epilepsy medication to be prescribed. As the medication was not a standard item held in stock and the prison, a signed prescription was required in order to obtain the medication from a local pharmacy. There was no authorised prescriber available at the prison until Monday. On Sunday afternoon Martin had two epileptic seizures in his cell, followed by two smaller seizures while being treated by the ambulance crew. Martin was taken to the local emergency department (ED) where he was assessed and given Tegretol. Martin spent the next three hours in the ED, and was then taken back to the prison.

Written communication

Although face-to-face communication is recommended, in practice, written communication is the most usual means of communication between healthcare workers [9]. The HSE provides a detailed explanation of what should be included in patient record and how information should be recorded [10]. The Royal College of Nurses provides the following principles for written communication [11]:

- write up notes as close as possible to the time you delivered the care;
- use clear and simple writing;
- write legibly (if hand-written) and error-free if using a computer;
- insert dates and times as accurately as possible and note when specific events and circumstances occurred;
- avoid personal opinions; and
- report factually what you have observed- avoid writing anything judgemental or which may seem personally abusive or insulting.

Conclusion

Communication is fundamental to safe and effective patient care. Communication underpins all of the other nontechnical skills, but is particularly crucial for teamwork. As such, it is important that healthcare workers give careful consideration to verbal and written communication, and active listening.

Practical applications

- Consider applying some of the techniques used to support effective communication in aviation in your own practice.
- Practice active listening- try and avoid 'gap searching'.
- Use a structured approach to handover such as ISBAR$_3$.

Online resources

- HSE Clinical handover education programme and videos: healthservice.hse.ie/about-us/onmsd/quality-nursing-and-midwifery-care/clinical-handover-education-programme-videos.html.
- The HSE National Healthcare Communication Programme has a number of useful web-based support materials (e.g. videos, case studies, skills cards). See: www.hse.ie/nhcprogramme.
- Royal College of Nurses: https://rcni.com/hosted-content/rcn/first-steps/communication

Relevant HSeLanD training

- Communication
- Effective team communication

Additional readings

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Chapter 7.
Teamwork and Leadership

Introduction

A team can be defined as two or more people with meaningful task interdependence [1]. Effective teamwork between healthcare workers is a critical element of safe and high quality healthcare. Evidence has shown that teamwork is related to patient outcomes such as the patient morbidity, mortality, complications, and to process outcomes such as timeliness of care, error rates, and length of stay [2]. Teamwork is also related to job satisfaction, well-being at work and the cost of running a hospital [3,4]. Healthcare organisations are really 'teams of teams', and healthcare workers may be in more than one team simultaneously. For example, an anaesthetic nurse is in the theatre team, but also in the anaesthetic team, and the nursing team. A paramedic is part of the ambulance team and also becomes part of the ED team during the transfer of care to the ED. This multiple and synchronous team membership creates complexity in terms of lines of authority, and there may be differing and competing goals within and between different teams.

Why should I read this chapter?

This chapter will describe the key elements of teamwork that impact upon patient/service user care. Healthcare workers should read this chapter because teamwork is crucial to the provision of quality healthcare across the health service.

Teamwork attributes

For a team to operate at a basic level of effectiveness it should have the following characteristics [5]:
- individual task proficiency;
- clear, concise communication;
- task motivation;

- collective orientation- a belief that the team's goals are more important than those of the individual; and
- shared goal and mission.

A systematic review of the healthcare literature found the following key elements of teamwork that impact upon patient/service user care [6]. Each of these elements is summarised in the table below, and then discussed in more detail.

Quality of collaboration	- Respect and good will between team members. - Mutual respect. - Trust.
Shared mental models	- A common understanding between team members. - Shared goals. - Shared perception of a situation. - Shared understand of team structure, team task, etc.
Coordination	- Team members actively working together. - Adaptive coordination (e.g. shift between implicit and explicit coordination). - Mutual support.
Communication	- The effective exchange of information. - Openness. - Quality. - Specific communication practices (e.g. handover).
Leadership	- Effective and dynamic management of a healthcare team. - Adaptive leadership (e.g. increased explicit leadership in critical/high risk situations).

Quality of collaboration

High performing teams have a climate of openness and trust, where team leaders are receptive to alternative views and team members are not afraid to express them. This atmosphere of trust and respect is encompassed in the notion of psychological safety. When there is psychological safety, healthcare workers will feel able to take interpersonal risks to engage in effective teamwork and to maintain patient safety.

Research on collaboration in healthcare has tended to focus on situation in which there is a lack of collaboration or conflict [7]. Conflict can be defined as any dispute, disagreement, or difference of opinion related to the management of a patient/service user involving more than one individual and requiring some decision or action [8]. Conflict is prevalent in healthcare teams. Research had found

that conflict occurs during the management of 50% to 78% of patients, with 38% to 48% involving doctor-doctor conflict [9,10].

Conflict has a negative effect on patient care. Evidence shows that conflict between healthcare workers in different specialties is linked with less person–centred care, conflict between healthcare workers within the same specialty is associated with less timely care. For these reasons, it is imperative that hospital management recognise conflict as a threat to patient safety and quality of care and support conflict management programmes [11].

A differentiation can be made between task and relationship related conflict. Task related conflict emerges from differences in resource needs, workflow, compliance with policies and procedures and differences in opinion about appropriate care. For example, a disagreement between a nurse and junior doctor as to how a task should be carried out. Relationship related conflict is due to interpersonal dynamics, personality frictions and differences in norms and values. Relationship related conflict tends to be emotion focused rather than task focused. For example a personality clash between a nurse and junior doctor (see below).

Conflict between a junior doctor and a nurse

A patient was admitted to the ward and was going to theatre but had insulin dependent diabetes. The insulin had not been prescribed by the admitting doctor and the junior doctor was contacted by a member of the ward nursing team to prescribe the insulin. When the junior doctor arrived to the ward the nurse who initially contacted the junior doctor was on her tea break and left a message for the doctor to come to her in the break room to discuss it further. The junior doctor refused and said if the nurse did not return to the ward then he would leave without prescribing the insulin. The nurse did return and had a heated argument with the doctor about the situation in the corridor. The junior doctor felt aggrieved that the nurse "didn't have the manners to come out to the office from her break and discuss it with him". The nurse did not understand the issue. She felt aggrieved that the junior doctor "wouldn't just come into the tearoom".

The Clinical Nurse Manager (CNM) was asked by the nurse to intervene in the disagreement. Both the junior doctor and the nurse agreed that they were stressed and tired. The nurse had a heavy caseload of sick patients and this was her first time to have a break in hours. The junior doctor had three wards to cover and he was working alone. The CNM felt that both the junior doctor and the nurse had quite strong personalities and neither would give an inch, but she managed to mediate in order to get the best possible outcome. The CNM felt "calmness and understanding was required". The insulin was prescribed and the nurse returned to her break.

Unresolved task conflict can evolve into relationship conflict. This is a problematic situation because relationship conflict is harder to resolve and it tends to last longer. Relationship conflict is also very detrimental to team performance and patient safety [11].

Resolving conflict in healthcare teams requires mutual respect amongst the team members, listening to grievances, sticking to the issues, recognising differences in opinion, and acknowledging the emotional aspects of a disagreement [12]. A number of approaches to managing conflict in healthcare teams have been identified:

1. Anticipate conflict.
2. Develop communication skills.
3. Identify the precise source of conflict.
4. Establish rules of conduct.
5. Find a non-judgmental starting point for the discussion.
6. Establish shared standards and goals.
7. Recognise any shared frustrations with the system.
8. If conflict with a colleague is necessary, it should be conducted in a private setting.
9. Bring in an uninvolved colleague early, to help resolve the conflict.
10. If conflict is ultimately irreconcilable, transfer patient care to an uninvolved colleague [10]

Shared mental models

A shared mental model provides team members with a common understanding which then allows the team members to form accurate explanations and expectations about the task, as well as co-ordinating their actions and behaviours with other team members. An example of what it is like when a team has a shared mental model is explained by a surgeon:

'it's as if it's choreographed in theatre- everybody is in the right place, at the right time, and doing the right thing' [7].

However, when the team does not have a shared mental model things are much more challenging:

"maybe I wasn't clear enough, but they didn't know what I needed or what I wanted" [13].

The most effective way to achieve a shared mental model is through good communication. Time-outs, briefings, and handovers are critical to developing shared mental models. Therefore, the communication techniques described in the previous chapter are crucial to building a team mental model.

Coordination

Coordination is the ability of team members to work together, anticipate each other's needs, inspire confidence, and communicate in an efficient manner. In well-coordinated teams, the team members will assist others if they are having difficulty or have become overloaded, and will consult with other team members when uncertain. A high performing healthcare team is not simply a group of skilled individuals. Rather, the activities of the individuals in the team must be coordinated in order to allow the team members to perform multiple simultaneous and interdependent tasks. Poor coordination results in breakdowns in communication, increasing errors, and conflicts (see the example below).

Coordination can be explicit or implicit. Explicit coordination is concerned with the use of communication to directly exchange information with other team members. In explicit coordination there is a deliberate effort to coordinate the activities of the team. Explicit coordination has been found to be appropriate in novel situations and during decision making [14].

> **Lack of coordination in the operating theatre**
>
> A Consultant surgeon arrived late for a planned elective laparoscopic surgery. The Consultant missed the pre-surgery brief. The Consultant spoke to the Registrar by phone and told him to go ahead and begin the procedure. The Registrar commenced the procedure as directed, with the Consultant taking over when he arrived. However, there were some complications with the procedure. The Consultant and Registrar step away from the patient to review the computerised tomography (CT) to address the unanticipated complication. The Consultant decided to convert from a laparoscopic to open procedure, but did not discuss this decision with the other members of the theatre team. The Consultant surgeon returns to the patient and proceeded to open the patient's abdomen. The scrub nurse asks '*are you doing 'open' now? But I don't have the open tray here, it will take time to get it in here*' on hearing this the Anaesthetist then exclaimed '*wait, you are going to 'open'? but I don't have any blood cross-matched or ordered!*''.

Implicit coordination is less effortful, and is concerned with one team member anticipating the needs of another. For example, a nurse opening an additional packet of sutures for a doctor closing a wound without being asked to perform the task. Implicit coordination requires the team members to have a common understanding of the task and what the other team members need to support the task. Similar to mental models, implicit coordination can be developed through experience, practice, and working with an established team.

Leadership

The traditional model of leadership in most areas of healthcare is hierarchical, with one person directing the other members of the team. This style of leadership is consistent with a transactional leadership style. Transactional leaders gain compliance from team members through goal setting, agreeing on what needs to be accomplished, monitoring performance, and administering reinforcement if required. Certainly the behaviours of a transactional leader, particularly in the day-to-day running of a healthcare team, are important. However, high performing leaders are also transformational leaders [15]. Transformational leadership is positively related to team performance, satisfaction, and commitment. Transformational leaders are charismatic, inspiring, stimulating, and considerate. They give team members a sense of purpose, self-confidence, and self-belief.

Effective leadership for healthcare teams is flexible, meaning that it is shared and distributed [16]. Leadership is often required from many team members- not just the formal team leader. For example, in multidisciplinary teams it may be necessary for different healthcare specialties to lead on different aspects of a patient's care. Distributed leadership is also important in high risk and time pressured

situations in which a single leader may become overloaded, or in a life-threatening situation in which there may be a need to act before receiving approval for the formal team leader. Therefore, there is a need for team members to understand when they need to take a leadership role.

Situational leadership

No one leadership style is appropriate for every situation. Situational leadership teaches us that the appropriate style of leadership will depend on the context and the task. Good leaders will know when it is appropriate to be directive, persuasive, advisory or supportive. Usually in critical and time urgent situations a directive leadership styles is appropriate. In other situations encouraging the freedom of action of subordinates is more appropriate so advisory and supportive styles should be used.

Finally, it is crucial that healthcare leaders are good role models. Senior personnel can have a direct effect on team culture by modelling safe behaviours and reinforcing the behaviours of juniors through monitoring and feedback. The importance of good role models cannot be overstated. For example, strong role models was rated as the second most effective strategy to improve hand hygiene behaviour in the ICU, the availability of essential supplies was the only strategy rated higher [17]. If leaders do not demonstrate a personal commitment to standards, it is difficult to expect it from others. Leaders can also have an indirect effect on team culture by establishing norms of behaviour, particularly in relation to practices and procedures.

Interventions to foster team work

There is irrefutable evidence that team training can improve team performance. Both simulation and classroom-based team-training interventions can improve teamwork processes (e.g., communication, coordination and cooperation), and implementation has been associated with improvements in patient safety outcomes [18, 19]. See chapter 11 for an example of a team training intervention. Effective communication is fundamental to effective team work. Therefore, the communication techniques discussed in the previous chapter are relevant to effective team work.

A particular technique that has not been discussed previously, and can support future team performance is team debriefing. Debriefing usually occurs after a task or procedure has been completed. The purpose is to review how the task went from both a technical and a nontechnical perspective. The debriefing should cover what went well, what did not go well, and how things could be improved in the future [7]. It is easy for a team to fail to debrief - particularly if everything went to plan. Often the last thing people may want to do after completing a procedure is to spend time discussing their performance. In a survey of Irish surgeons, no trainee surgeons agreed with the statement that 'adequate post-operative briefings are conducted frequently' as compared to 19% of Consultant surgeons who agreed with that statement [20]. Debriefing and feedback are particularly important for juniors who are interested in learning and improving their future performance. Senior team members are crucial in ensuring that effective debriefing takes place, particularly if things have not gone well.

A particular method of debriefing called After Action Review (AAR) is commonly used as a means of helping team members understand what happened in an event. In an AAR, the discussion is structured around four questions: what went well?, why?, what did not go well?, why? These questions allow team members to agree on what they would do differently in the future and what learning can be identified to inform improvement [18].

Conclusion

Effective teamwork is crucial to patient safety, work satisfaction and efficiency. No one in healthcare works in complete isolation. Leadership is recognised as critical in establishing the culture within teams. Leaders must lead by example and must demonstrate their commitment to standards of care as well as hospital policy, practices and procedures. However, it is well recognised that leadership can come from all levels and all disciplines within the healthcare system.

Practical applications

- Review the characteristics of a high performing teams, and try and apply them to the team(s) in which you work.
- Identify how conflict can be reduced and managed in your own team.
- Consider how flexible and distributed leadership can be fostered in your team to establish, maintain, and update shared mental models.
- Identify when and where implicit or explicit coordination is most appropriate in your team.
- Act as a role model for how you believe a healthcare worker should behave- particularly if you are a senior member of a team.
- Consider how you can demonstrate leadership within your own area of practice.

Online resources

- Managing conflict: NHS Improvement. Online library of quality, service development and redesign tools. Available from: www.england.nhs.uk/wp-content/uploads/2021/03/qsir-managing-conflict.pdf
- The HSE National Healthcare Communication Programme has a number of useful web-based support materials (e.g. videos, case-studies, skills cards). See: www.hse.ie/nhcprogramme.
- TeamSTEPPS- a team training intervention developed by the Agency for Healthcare Research and Quality. A huge amount of resources are available here: www.ahrq.gov/teamstepps/index.html

HSElanD training

- Being an effective team member
- Establishing team goals and responsibilities

- Handling team conflict

Additional readings

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Chapter 8.
Organisation and Management

Introduction

All work in healthcare happens within the context of the organisation, its goals, its culture, its systems, and the processes, policies and procedures that are in place to support the work. In high performing healthcare organisations, all of these factors support a common goal, of safe and effective patient care.

Why should I read this chapter?

Those at managerial and strategic levels set organisational goals and strategies and thus have the potential to have great impact on organisational goals and culture. This chapter will address the key role of managers and leaders in setting organisational goals and determining organisational culture. This chapter will discuss why a blame culture has a negative impact on patient safety, and consider how establishing an appropriate safety culture can be achieved. Healthcare workers should read this chapter because they should consider whether the systems, policies and procedures of the organisation in which they work support the delivery of care. They should also be aware of the negative impact of blame on safety and strive to contribute to developing a positive safety culture within their work unit.

Management priorities, goals and policies

Management priorities, goals and policies affect almost every aspect of an organisation. Clearly managers must balance the competing demands of cost, safety, quality and the needs of staff and patients/service users. However, decision making can become skewed if management loses sight of its key function which is to provide safe and effective care. An example of when there was a loss of focus on care is clearly evident in the case of the Mid-Staffordshire Hospital Trust in the UK. The

executive leadership's focus on economic and financial considerations, at the expense of patient care, permeated throughout the entire organisation.

Mid Staffordshire NHS Foundation Trust Scandal [1].

A public inquiry into Mid Staffordshire NHS Foundation Trust 2013 in the UK found that patients suffered, and in some cases were harmed, due to 'appalling care' from 2005 to 2009 [1]. Up to 300 cases have been identified in which neglect may have contributed to the death of patients. A lack of basic care was found across a number of wards and departments. For example, patients were left in soiled bed clothes for lengthy periods, and staff treated patients with callous indifference. The detail of the failings, and a review of the 290 pages of recommendations from the enquiry, are too much to discuss here. However, a key issue was the focus of senior management on cutting costs, rather than patient care.

In contrast to the Mid Staffordshire NHS Foundation Trust Scandal is the example of the Salford Royal hospital and the exemplary leadership of the hospital CEO, Sir David Dalton. Under his leadership, the hospital went from a poorly performing organisation to one of the top performing hospital trusts in the UK.

Building a safety culture: Salford Royal NHS Foundation Trust [2].

Beginning in 2007, Salford Royal NHS Foundation Trust engaged in a process of quality improvement focused on changing the safety culture of the organisation. The efforts of the 6,500 staff resulted in the Trust being in the top 10% of NHS organisations on risk adjusted mortality, and receiving the highest staff satisfaction/engagement rating of any acute trust. Over 90% of patients rate their care as 'excellent' or 'very good', with over 97% of patients receiving harm-free care.

The executive leaders developed a quality strategy to: reduce mortality; improve patient experience; reduce harm; and improve reliability. This strategy was supported by a focus on delivering safe care (the trust's watchwords being 'safe, clean, and personal'). The Trust's staff were trained, and expected to be patient and customer-focused, supportive of continuous improvement, respectful, and accountable. The staff received further training in quality improvement, which was then applied in a rolling programme of quality improvement projects.

The Trust also changed the structure of the organisation, and the relationship and role of the executive team. Four clinical divisions were formed- each led by a clinical chair supported by a managing director and nursing director. Each division was responsible for their own budget and services. There were investments in the development of medical leaders to ensure that clinical chairs and clinical directors had the skills needed to work effectively in the new structure.

Particular executive team members were associated with each of the clinical divisions. However, the role of the executive team members were as coaches and advisors rather than managers. Executive team members were involved in quality improvement efforts through safety walk arounds and by spending time with, and talking to front line staff. The trust board monitors progress on the strategy through regular performance reports and revising goals for improvement as necessary.

Dalton placed patient safety and quality of care at the very centre of all decisions taken by the executive board. He identifies several factors as crucial to the success of the Salford Royal [3].

- Creating good governance structures that span the entire organisation.
- Breaking down departmental and service silos that stifled the flow, learning, and governance.
- Creating new risk management strategies which involved first identifying and acknowledging the risks in the organisation.
- A commitment to continuous improvement- including a recognition that improvement capability can be found within the hospital staff, not a boardroom level.
- Investment in developing staffs capability to lead improvement efforts.
- Visual leadership- working alongside staff to understand system risks and problems and impediments.
- Authenticity- talking about patient safety and quality of care, and not finance or targets.

The improvements at Salford Royal are supported by evidence emerging from a recent study of high performing hospitals. This study identified seven key factors associated with high performing hospitals [4]:

1. Positive organisational culture.
2. Senior management support.
3. Effective performance monitoring.
4. Building and maintaining a proficient workforce.
5. Effective leaders across the organisation.
6. Expertise-driven practice.
7. Inter-disciplinary teamwork.

Policies and procedures

Issues with policies and procedures can arise where there is a difference between how managers *believe* work is being performed (sometimes described as 'work-as-imagined') and how the work is *actually* being done by healthcare workers (described as 'work-as-done')[5]. To be effective, it is important that policy is consistent with how work is being done. Where there is discordance, there is a need to change either how work is being done, or change the regulations such that they are consistent with how the work is being done. It has been suggested that in healthcare "*there is a difference between policy and practice…and that administrators may not be aware of the latter*" [6]. Therefore, it is very important that policy writers have an accurate understanding of how healthcare

workers carry out their work, and that front line workers are involved in the drafting of policy. This mutual understanding will ensure that policies support, rather than hinder, the delivery of safe and effective care.

Organisational culture

Organisational culture can be described as the shared meaning the workforce attach to the policies, practices and procedures they experience and the behaviours they observe being rewarded, supported and expected [7]. In healthcare organisations with poor cultures, the espoused values and goals of the organisation do not match with what is expected (and tacitly rewarded) on the front line. This dissidence creates a dangerous precedent where front line staff may pick and choose which policies they adhere to and which they ignore. An appropriate culture is crucial to the provision of safe and effective care, and to support learning from things that go wrong. First line supervisors have a critical role in setting the work climate and influencing the performance of the unit [8]. In high performance healthcare organisations, all leaders (from the very top to the front line) share an attitude that high quality, safe and compassionate care is the core purpose of the organisation [9]. This attitude should be backed up by policies and procedures that support this approach to patient care. Therefore, although managers and executive leaders may be removed from the delivery of care, their influence on front line care is evident.

Blame culture

Although there is increasing recognition of the need to take a systems perspective when adverse events happen in healthcare, the impulse to name, blame, shame, and re-train individuals is still very strong. Blaming individuals is emotionally satisfying, quick, easy, and shields senior and middle level managers from scrutiny and responsibility. In his report on the Mid-Stafford inquiry, Sir Robert Francis said that "*the understandable human need to identify one or more people to be held to account means that whenever something goes wrong a hunt starts, and the larger the disaster the more pressure there is*" [1]. However, he goes on to make the point that if the inquiry was to fulfil its main purpose of learning, then it must focus on identifying lessons to be applied, rather than targeting people to blame for the failings of the Trust. A focus on identifying someone to blame for an error fails to consider the other factors in the system that contributed to the error (discussed in detail in chapter 10). A focus on blame also means people are more likely to cover-up, rather than report errors. Unfortunately, the treatment of Dr. Bawa Garba in the UK suggests that the healthcare industry has not yet dispensed with a blame culture.

Example of a blame culture: Dr. Bawa Garba [10]

On 18 February 2011, six-year-old Jack Adcock, who had Down's syndrome and a heart condition, was admitted to Leicester Royal Infirmary in the UK. He was suffering from sickness and diarrhoea. Jack was under the care of Dr Bawa Garba (a trainee paediatrician). Jack died 12 hours after admission following a delayed diagnosis of sepsis.

As a result of Jack's death, Dr. Bawa Garba was found guilty of negligent manslaughter and given a two years prison sentence and suspended from work for 24 months. The Medical Practitioners Tribunal (MPT) subsequently suspended her from practice for a year. The General Medical Council (GMC) subsequently challenged the MPT decision in the High Court. The GMC won the appeal and Dr. Bawa Garba was erased from the UK medical register. In August 2018 Dr. Bawa Garba won an appeal against her erasure, and was reinstated on the UK medical register.

The conditions under which Dr. Bawa Garba was working on the day of Jack's death were described as appalling. The contributing factors that led to Jack's death were:
- the patient had complex needs;
- Dr. Bawa Garba had recently returned from 13 months of maternity leave;
- there was no senior consultant available, leaving Dr. Bawa Garba with sole responsibility for the whole Children's Assessment Unit;
- Dr. Bawa Garba was covering two to three colleagues, and 6 wards over four floors inputting to two surgical wards, GPs, and midwives;
- under Dr. Bawa Garba, was a foundation doctor and SHO both new to paediatrics;
- there was a shortage of nurses- Jack's assigned nurse had a certification in adult nursing; and
- there was an IT failure which led to delays in obtaining test results.

This adverse patient outcome, like most adverse events in healthcare was a multi-causal event. Blaming one individual for system level failures only serves to make the system risker by implicitly encouraging staff to cover up their mistakes and thereby inhibiting learning. Jenny Vaughan, Law and Policy Officer for the Doctors' Association UK said there is a culture of blame that, if left unchecked, "will mean patient safety is not what it should be as staff will be too scared to admit their mistakes."

If healthcare is to become safer, there is a need to move beyond the blame of individual healthcare workers and establish what has been described as a safety culture. In testimony to the U.S. Senate in 1997, Prof. Lucian Leape identified "*the single greatest impediment to preventing harm is that we judge and punish people for making mistakes*".

Similarly, Sir Prof. Ian Donaldson, the UK's former Chief Medical Officer, said "*to err is human, to cover-up is unforgivable, to fail to learn is inexcusable*." We need to accept that healthcare workers will make

errors, and that these errors will sometimes cause harm to patients/service users. Any error that negatively impacts a patient/service user is regrettable. However, what is most important is that lessons are learned from these errors.

Safety culture

Safety culture is a facet of organisational culture that captures attitudes, beliefs, perceptions, and values about safety. In describing how to engineer a safety culture, Reason [11] outlined the main elements of such a culture. These elements can be conceptualised as the engine that drives an organisation towards the goal of maximum safety. The power of this engine relies heavily on a continuing respect for the potential hazards associated with the organisation's activities 'not forgetting to be afraid', sometimes termed 'chronic unease'. This 'preoccupation with failure' is a hallmark of what have become known as high-reliability organisations (e.g. aviation, nuclear power generation). High reliability organisations do not ignore any failure, no matter how small, because of the potential for disaster [12]. The five elements of safety identified by Reason are an informed, reporting, just, learning and flexible culture.
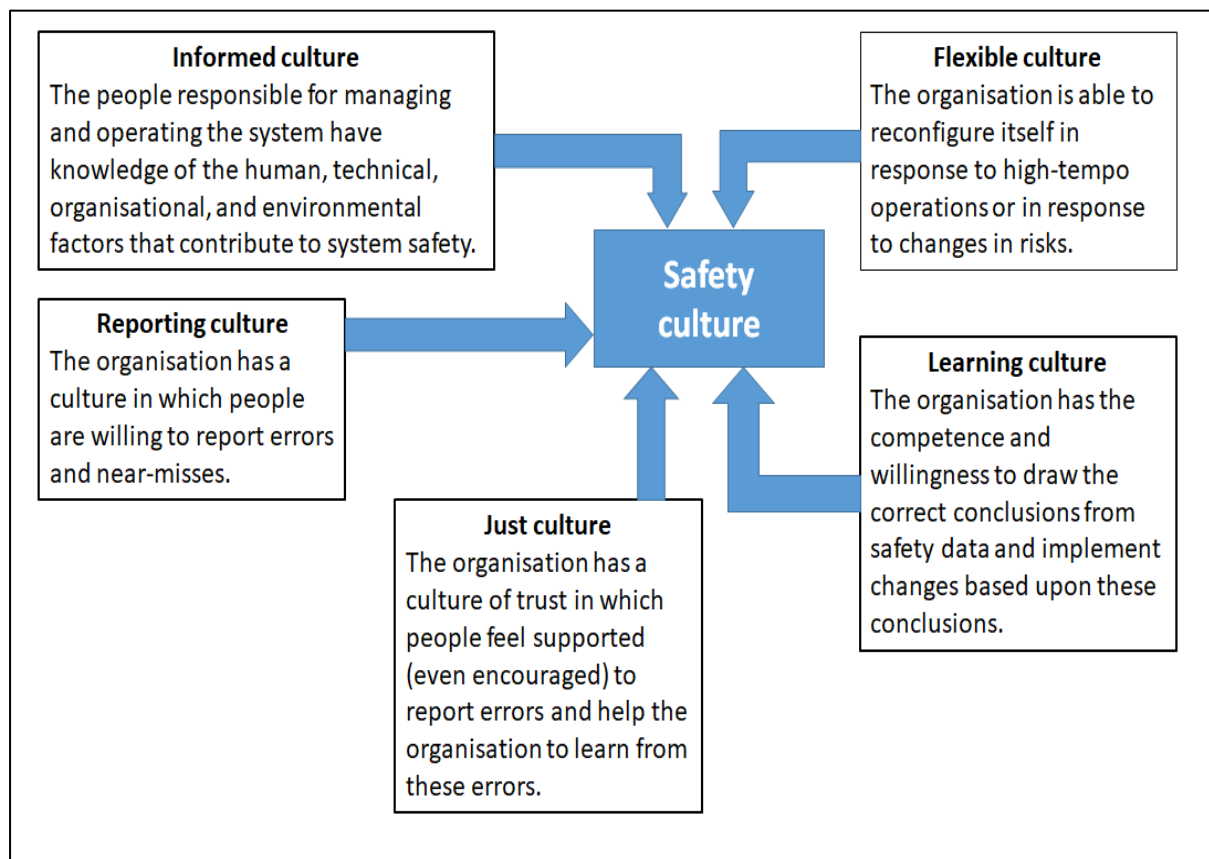
Below the five elements of Reason's safety culture model are applied to the findings of the Frances enquiry into the Mid-Staffordshire hospital (discussed earlier in this chapter). It can be seen that this hospital violated each of the five elements of a safety culture.

Poor safety culture example: Mid Staffordshire NHS Foundation Trust Scandal [1]

Informed culture. Despite many warning signs of major problems in patient care, issues were not addressed by the leadership. Hospital leaders failed to appreciate the enormity of the problems with patient care. They either reacted too slowly, did not react at all, or downplayed the significance of the evidence showing serious patient safety problems.

Reporting culture. In 2010 the Secretary of State for Health said in Parliament that there "*was a culture of fear* [in the Mid Staffordshire NHS Foundation Trust] *in which staff did not feel able to report concerns; a culture of secrecy in which the Trust board shut itself off from what was happening in its hospital and ignored its patients; and a culture of bullying, which prevented people from doing their jobs properly*."

Just culture. Staff and patients did not feel supported to report problems, and struggled to get their voices heard. In fact, staff were encouraged to cover up evidence that they were not meeting targets. Staff that refused to cover up were subject to bullying. The Secretary of State for Health said "*they* [the people of Staffordshire] *were badly let down. I pay tribute to the people who had the courage to come forward and tell their stories and to expose the failures of the past, in order that they could protect others in the future*."

Learning culture. There was no desire to respond to any information that indicated the need for improvement. Leadership took false assurance from good news, and yet tolerated or sought to explain away bad news. For example, in response to the finding for a patient survey, managers only focused on the areas in which the Trust did well or performed satisfactorily. They downplayed the areas where the hospital performed badly. Overall, the hospital was shown to be in the bottom 20% in England based on the results of the survey.

Flexible culture. The Trust leadership were inflexible, and did not respond to the reduction in the quality of care resulting from their desire to cut costs. The leadership continued to reduce expenditure despite the fact that serious problems had been identified in the delivery of care. The focus of the leadership was on economics and not patient care- this focus permeated throughout the staff at the Trust.

Assessing safety culture

The most common method of assessing safety culture in healthcare settings is through the use of surveys. These are called safety climate surveys as they are considered to be a measure of safety culture at a single point in time (i.e. when the survey was distributed). There are a range of measures of safety climate developed for use with staff in primary care [13], secondary care [14], and other healthcare domains (e.g. prehospital care [15]). There are also measures of safety climate specifically designed to be completed by patients/service users [16]. When selecting a measure it is important to ensure that it is appropriate for the domain in which it is going to be used.

Practical applications

- Senior leaders must ensure that they are leading by example by ensuring that strategy and policy that inform work practices are focused on the delivery of care and support healthcare staff to do their work.
- People in leadership positions have a responsibility to foster an appropriate safety culture.
- Everyone working in a healthcare organisation must avoid the tendency to blame individuals when something goes wrong, and instead focus on learning from adverse events.
- Everyone working in a healthcare organisation must consider how they can contribute to the fostering of an appropriate safety culture.
- Senior leaders and managers should spend time on the front line observing the delivery of care, and talking to front line staff in order to understand the challenges faced by front line workers, and prevent a 'them and us' mentality.
- There should be continued efforts to embed incident reporting and patient safety issues in educational programmes at all levels in a healthcare organisation.

Conclusion

Although often removed from the delivery of front line care, managers determine the priorities and goals within their organisations and thereby have enormous impact on the practice and the culture of care delivery. Managers who do not come into regular contact with patients/service users or with front line staff, can become overly focused on budgets, targets, and costs. Senior and middle management visibility and engagement in front line work will help managers to maintain a vital link to care delivery and to understand their role in supporting the work. It is also important that healthcare organisations move away from a culture of blame. This is not to say healthcare workers should not be accountable for their actions. A safety culture does not excuse reckless behaviour where unjustified risks are taken. However, healthcare workers should not be held accountable for system failings over which they have little or no control.

Online resources

- NHS improvements just culture guide. Available from: www.england.nhs.uk/patient-safety/a-just-culture-guide/.
- Chris Ham in conversation with Sir David Dalton. Available from: www.youtube.com/watch?v=B3wgQxZW4fM&t=3s

Additional readings

- West, M. et al (2014). *Leadership and Leadership Development in Health Care: The Evidence Base*. King's Fund: London. Available from: www.kingsfund.org.uk/sites/default/files/field/field_publication_file/leadership-leadership-development-health-care-feb-2015.pdf

- Ham, C. (2014). *Reforming the NHS from Within*. King's Fund: London. Available from: www.kingsfund.org.uk/publications/reforming-nhs-within
- Institute for Healthcare Improvement. *Governance Leadership of Safety and Improvement*: www.ihi.org/Topics/GovernanceLeadership/Pages/default.aspx

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Chapter 9.
Society, Culture and the Regulatory Environment

Introduction

Society's cultural values directly impact healthcare regulation, and in turn, healthcare practices. The purpose of healthcare regulations are to: (1) ensure compliance with specific standards of healthcare delivery; and (2) empower organisations to meet these standards. When regulators lose a focus on the goal of delivering safe an effective care, this impacts healthcare organisations, the behaviours of healthcare workers, and has a detrimental effect on patients/service users. An example of this is the case of the Mid Staffordshire NHS Foundation Trust (discussed in the previous chapter), where government and regulators focused on the need for hospitals to meet national targets and achieve financial balance to the detriment of patient/service user care [1]. Clearly the goal of politicians and regulators was not to compromise care, but this example illustrates that laws, economic, regulatory context and funding priorities impact care delivery.

Why should I read this chapter?

This chapter will cover the challenges of effectively regulating patient safety, and the considerations that should be addressed when measuring and monitoring safety. Healthcare workers should read this chapter because they should consider how the regulatory environment can impact care.

Culture and regulation

Healthcare regulations do not exist in a vacuum. Research shows that society's cultural values have a significant effect on regulatory policies, and in turn, healthcare practices. In Ireland, this was clearly evident in the tragic case of Savita Halappanavar (discussed in more detail in chapter 4) where interpretation of national laws on the termination of pregnancy impacted upon the care received by the patient [2]. Recent regulation around open disclosure is another case in point. Cultural values

around our right to know the truth about our care has led to regulations that mandate what, when, and how patients/service users should be told about errors in their care [3].

Characteristics of healthcare regulations

The characteristics of effective healthcare regulations and the role of an effective regulator have been defined in the literature [4]. Regulations should:
- be flexible, adaptive, and targeted;
- require involvement of stakeholders in both the development and assessment of a regulation;
- employ a range of regulatory strategies and mechanisms, involving both informal and more formal (statutory) approaches to ensure integrity and credibility; and
- provide for mechanisms to ensure that the regulator is independent and impartial while being accountable for the effects of regulation.

However, there are challenges to developing effective regulations in healthcare.
- It is no longer sufficient to regulate and accredit individual structures and institutions, rather it is now necessary to accredit patient/service user journeys across prehospital, primary, secondary and community care.
- Healthcare is a rapidly evolving system. In such systems the regulator invariably lags behind the pace of change.
- Consideration must be given to how to respond when standards are not achieved or how to close the gap between current and desired performance, and importantly how to manage safety in the interim [5].

Regulations, safety and improvement

Ideally healthcare organisation and regulators will work together to develop suitable regulations. This approach is referred to as a 'hybrid' approach between a 'top-down' focus on compliance/sanctions along with a 'bottom-up' focus on supporting improvement [6]. However, regulators have struggled to reach a balance between sanctions and support [7]. There is a strong case for encouraging a bottom-up approach because it is only through local engagement that healthcare organisations can adapt national goals and regulation to fit local contexts. In addition, front line workers can provide contextualised local knowledge of what is required and how it might be achieved [8]. Therefore, healthcare organisations must invest in the improvement capacity of health service staff with the objective of generating responsive 'learning organisations' [9].

Evaluating safety performance

Evaluating compliance with standards is a key function of the regulator. However, it is important to differentiate between evaluating for *judgement*, and evaluating for *improvement* [10]. Evaluating for judgement involves establishing whether organisations meet a specific set of standards and benchmarks of performance. Evaluating improvement is about measuring whether the efforts

organisations are making to improve actually result in improvement. Irrespective of the purpose, evaluating healthcare performance requires the collation of performance information. Currently, a major challenge to improving safety is the lack of high quality information to allow organisations, teams, and individuals to evaluate how they are performing, and where there are deficits and risks [11]. This safety information is complex and multi-faceted, yet vitally important if safety is to be improved [12].

The HSE recognises the need for "*information from various sources to provide intelligence that will help us recognise when things go wrong, and to measure, monitor, and recognise improvements in patient safety*" (p.12)[13]. The lack of reliable data on safety is a hindrance to safety improvement. A reason for this lack of reliable data is that there is no consensus on how safety should be measured [1]. Therefore, most healthcare organisations "*have little capacity to analyse, monitor, or learn from safety and quality information. This gap is costly and should be closed*" (p.27)[9]. The Francis report into the poor treatment of patients at the Mid Staffordshire NHS Foundation Trust (see chapter 8) identified the measurement of safety as an absolute priority for healthcare organisations [1].

It is important to make the point that the issue may not be a lack of data, but rather an absence of the *right* data. Professor Don Berwick (a leading patient safety advocate) said that there is excessive mandatory measurement in healthcare- "*much of which is useless*" (p.1329)[14]. Professor Berwick goes onto say that healthcare stakeholders could get the information they need with 25% of what is currently being spent on measurement [14]. To illustrate, the teams responsible for improving patient experience in NHS England speak of devoting much of their time to collecting, collating, and reporting of mandatory data (at a cost of £1.5m in 2016/17)[15]. The focus of policy makers was on obtaining adequate response rates, with little focus on actually using the data for safety improvement [15]. This issue is further compounded by setting targets for safety. Goodhart's Law says that *when a measure becomes a target*, it cease to be a good measure. For example, when a specific goal for hand hygiene compliance is established (e.g., achieve 90% compliance in hand hygiene audits), healthcare workers will be motivated to achieve this goal during the audit. However, this level of compliance may not be reflective of everyday levels of compliance when the healthcare workers are not being observed for an audit. This is not to suggest that healthcare workers are dishonest or duplicitous. Rather, they want to show their best to the auditors.

Measuring and monitoring safety

In order to identify how safety should be measured and monitored, Vincent et al [12,16] developed the measuring an monitoring safety framework shown below. An effective safety monitoring system should address all five of the dimensions in the framework. However, most safety monitoring systems have evolved, rather than designed. Moreover, often they may be focused on only a subset of the five dimensions. This means there is often over-measurement in some of the dimensions, and 'blind-spots' in other dimensions. For example, a systematic review of 52 studies reporting the measurement and

monitoring of safety in prehospital care found that almost three quarters of the studies assessed past harm, and only one considered the reliability of safety critical processes [17].
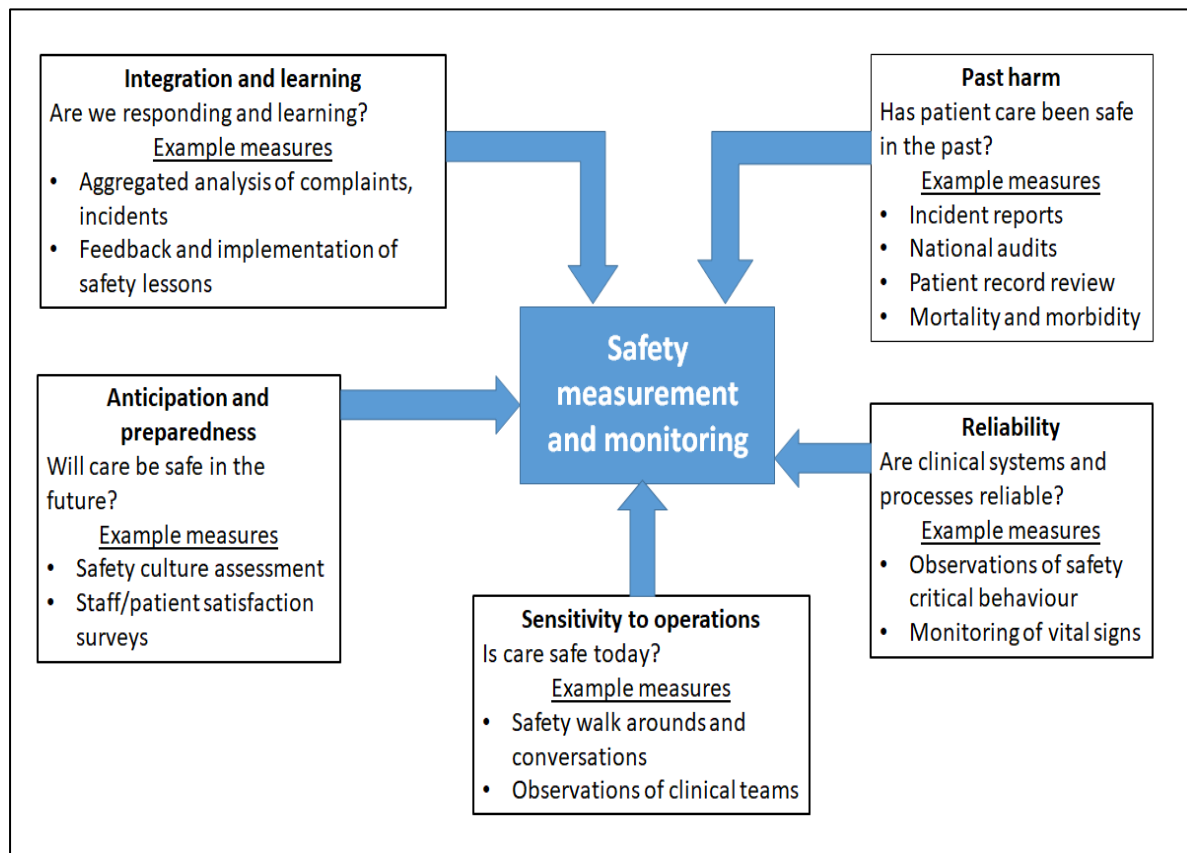
The measuring and monitoring safety framework can be used to promote reflection on how safety is measured and monitored at every level of a healthcare organisation. The framework supports the identification of where there are gaps in safety information, and promotes discussion of what could be done differently. A consideration of how safety is measured and monitored can support an approach to regulation that is not only focused on what standards should be achieved, but also provide insights into how these standards can be achieved. With committed leadership, applying the measuring and monitoring safety framework has been found to support a broad and rich approach to organisational safety [18].

Practical applications

- Everyone working in healthcare must consider the impact of regulations on the delivery of safe and effective care.
- Regulations that do not support the delivery of safe and effective healthcare must be changed (see the 'breaking the rules' intervention described in Chapter 12).
- Consider how safety is being measured and monitored in your unit or organisation. Are there blind spots in which there is no information, or are there are areas that are being over measured or monitored with limited actionable information?

- Is there a difference between work-as-imagined and work-as-done in your workplace? If there are differences, consider how the way the work is carried out can be changed in order to support the delivery of safe and effective care.

Conclusion

Regulations are an important means of setting safety standards, monitoring and enforcing compliance with those standards, and supporting progress towards improvement. This dual function of enforcement and empowerment can be a fine line to tread. '*The trick of successful regulation is to establish a synergy between punishment and persuasion*' (p.25) [19]. Good regulation will support organisations to adopt, adapt, and add to best practice [7].

Further readings

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- Vincent, C., et al. (2013). *Measuring and Monitoring of Safety.* London: The Health Foundation. Available online from: www.health.org.uk/publications/the-measurement-and-monitoring-of-safety
- Vincent, C., & Amalberti, R. (2016). *Safer Healthcare: Strategies for the Real World*. Springer Nature. Available online from: www.springer.com/gp/book/9783319255576

Online resources

- Goldmann D. What do we mean by measurement for judgment? Online video available from: www.ihi.org/education/IHIOpenSchool/resources/Pages/AudioandVideo/MeasurementForJudgment.aspx
- Safety differently- the movie. Online video available from: safetydifferently.com/safety-differently-the-movie/.

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those provided in University Hospital Galway, and as reflected in the care and treatment provided to Savita Halappanavar. Dublin: Author.

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Part 2
Applications of Human
Factors to Healthcare

Chapter 10.
The application of human factors to incident reviews

Introduction

The first part of this guide (chapters 1 to 9) provided foundational knowledge in human factors. The remaining two chapters will address applications of human factors principles to improve patient safety and quality of care. In this first of these 'application' chapters we will consider how to identify and analyse the human factors causes of adverse events. We will not address how to carry out an incident review in this chapter. This process is described in detail in the HSE incident management framework document [1].

An adverse event can be defined as "*an incident which results in harm, which may or may not be the result of an error*" [1]. It is widely recognised that many adverse events are preventable and often related to human factors. In fact, the World Health Organisation (WHO) stated, *"a failure to apply human factors principles is a key aspect of <u>most</u> adverse events in health care.*" (P. 100) [2]. In recognition of this fact, the WHO advocated that "*all healthcare workers should have a basic understanding of human factors principles"* (P. 100) [2]

Why should I read this chapter?

Healthcare workers should read this chapter because through increased knowledge and awareness of the causes of adverse events, they will be in a better position recognise risky conditions within the work system and thereby avoid them.

Approaches to incident reviews

We will explore two approaches to understanding adverse events in healthcare: (1) the person approach; and (2) the system approach. It is important to understand each approach because they each give rise to different philosophies of risk and error management.

- **Person approach.** The person approach is the traditional method to understanding adverse events. It focuses on the errors and unsafe acts carried out by healthcare workers. This approach is based upon the premise that errors and unsafe acts arise from individual level factors such as carelessness, inattention, negligence, recklessness and poor motivation. Therefore, this approach tends to lead to preventative measures that only focus on changing human behaviour. For example, ever-stricter rules and procedures, training, or removing those involved in the error or incident from the workplace (as in the Dr Bawa Garba case discussed in chapter 8).
- **Systems approach**. In contrast to focusing on the individual, a systems approach considers the context in which the incident occurred. Errors and/or unsafe acts are seen as consequences of system and task design as well as organisational process and procedures. Therefore, this approach tends to lead to a consideration of how and why the system failed rather than who made the mistake.

The Swiss cheese model

Probably the most influential model of accident causation was developed by Prof. James Reason and has become known as the 'Swiss Cheese' Model [3]. This model advanced our understanding of accident causation by helping us to understand accident trajectories.

The immediate cause of an adverse event is often an active failure by healthcare workers. **Active failures** can take many forms such as slips, lapses, or other types of errors. An active failure is often visible and obvious as it is the action that leads directly to the adverse event (e.g. gave the wrong drug). Focusing only on active failures (as in the person approach) is likely to be ineffective in identifying all of the other potential factors that may have contributed to the adverse event such as understaffing, inadequate equipment, poor supervision, lack of training, overcrowding etc. Reason calls these **latent conditions** because they lie dormant in the system until these conditions combine- often in unanticipated ways- with an active failure to create an adverse event.

Latent conditions can arise from decision made by managers, designers, schedulers, procedure writers, and/or policy makers; and they create error-provoking conditions within the workplace. Latent conditions can be more challenging to identify than active failures as they are more distal from the error. However, identifying and addressing latent failures is likely to have a much longer lasting effect, than simply focusing on the person who made the error. Identifying the latent conditions highlights where a system needs to be changed in order to minimise the likelihood of the error being repeated by another healthcare worker. The difference between active failures and latent conditions is illustrated in the description of a wrong route medication error discussed below.

Active failure and latent conditions example: inadvertent administration of an oral liquid medicine into a vein (adapted from [4]).

A nine-year-old child was admitted to hospital for an elective renal biopsy. This procedure involves taking a small piece of kidney using a special needle. A non-consultant hospital doctor (NCHD 1) prescribed midazolam (a sedative) to be given intravenously (IV). This was recorded in the patient's chart. However, the nurse preparing the medication in the treatment room assumed the medication was to be given orally and drew up oral midazolam into a purple syringe marked 'enteral'. Purple coloured or purple barrel syringes are intended for oral or enteral administration. The nurse and NCHD 1 followed a two-person checking process to ensure that the correct drug at the correct dose was administered in the correct way. However, the two-person checking process did not alert the doctor that the nurse had drawn up oral midazolam, nor alert the nurse that the doctor had prescribed an IV drug.

The doctor took the purple syringe to the room where the procedure was being performed, and passed it to a second doctor (NCHD 2) who attempted to administer the medicine intravenously. The nurse who prepared the medication was not present for the procedure.

NCHD 2 could not connect the purple syringe to the IV line- as it was designed so that the oral syringe could not be connected to an IV line. At this point, the administering doctor (NCHD 2) clarified with the prescribing doctor (NCHD 1) that the medication in the purple syringe was the intravenous preparation. Believing this to be the case, NCHD 1 transferred the oral midazolam into an IV syringe. The IV syringe was then connected to the patient's IV line.

NCHD 2 found it difficult to push the plunger of the syringe. Some of the medicine spilled from the syringe and the doctor noticed that it was sticky and sweet smelling. NCHD 2 realised that an oral preparation of the drug was being administered and she stopped the procedure and flushed the cannula with a saline solution.

The patient's mother was informed of the error. The patient was monitored for the next 24 hours. The patient then underwent the planned procedure under general anaesthetic and was later discharged with no apparent adverse effects.

Active failures

- Lack of attention by the nurse to the written prescription for IV medication.
- Lack of attention by NCHD 1 when given an oral syringe for an IV medication.
- Breakdown in communication between the nurse and NCHD 1.
- Failure of the checking process.
- Nurse who prepared the drug was not present at the procedure.
- Doctor (NCHD 2) who administered the drug was not present at the checking process.
- Bypassing the physical barriers designed to prevent administration errors.

Latent conditions

- Culture, communication and teamwork.
  - Lack of speaking up or questioning.
- Training, Knowledge and experience.
  - A lack of knowledge of the medication.
  - Inexperienced nursing staff and poor skills mix within staff.
  - Unfamiliarity with the design and use of oral/enteral syringes.
  - A lack of understanding about the purpose of the colour coding of syringes among doctors.
- Procedural and policy shortcomings.
  - No standard operating procedure for invasive procedures incorporating renal biopsy.
  - No structured process to ensure each team member understood their own role and the roles of colleagues.
  - No local sedation policy for children.
  - Staff shortages and high workload.

Yorkshire Contributory Factors Framework

The Yorkshire Contributory Factors Framework (YCFF) operationalises the systems approach to adverse event analysis [1,5]. This framework is used in the HSE, and other healthcare jurisdictions, to support the identification of causes of adverse events [1]. As can be seen on the figure on the next page, the YCFF provides a structure to encourage the consideration of all potential causes in the healthcare system. Suggested readings that provide more detail on the YCFF are provided at the end of the chapter.

Adapted for Lawton et al [5]
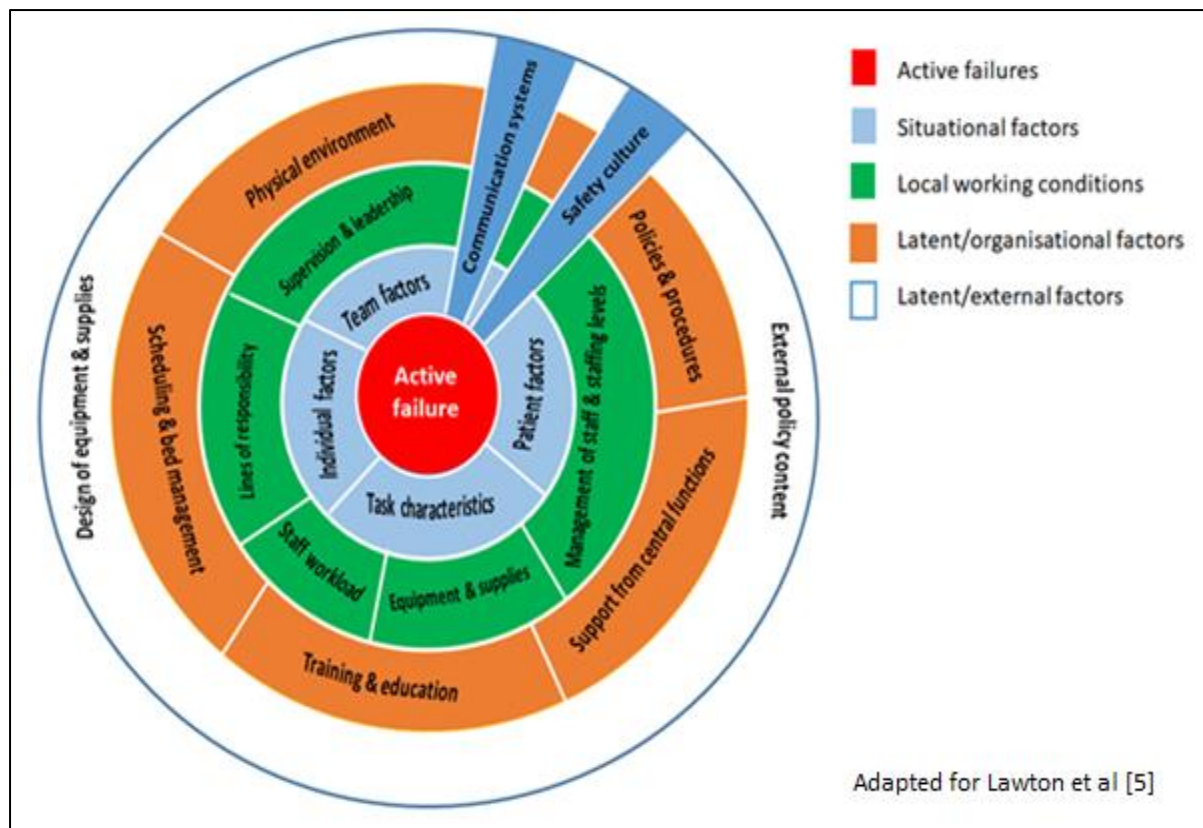
Safety I and Safety II

This chapter has focused on improving safety through the analysis of adverse events. This has been described as a Safety I approach to safety improvement. However, the vast majority of healthcare is delivered safely. Considering how we can learn from the everyday provision of good care has been described as a Safety II approach [6]. Therefore, although this chapter has focused mainly on identifying the contributing factors to adverse events, much learning can also come from applying the same scrutiny to identifying the contributing factors to good care. An example of a Safety II approach is the always event intervention described in the next chapter.

Practical applications

Healthcare workers should:

- be more aware of error provoking conditions in the work place and take action to resolve them;
- avoid blaming individuals when errors occur but seek to understand the underlying causal factors, within the system, that contributed to the error;
- adopt a learning approach by becoming involved in incident review and analysis of adverse events; and
- consider learning from what has gone well, and reflecting on cases with positive outcomes in order to identify the causal factors of good performance.

Conclusions

Taking a systems approach to understanding and analysing adverse events, using a tool such as the YCFF, will ensure that the latent conditions that contributed to the adverse event are identified. This ensures that the limited resources are being used to address the *actual* contributors to adverse events to ensure that they do not re-occur. Also, remember that the same approach that is used to analyse adverse events can be taken to learning from examples of good or exceptional performance. Identifying the latent factors can support an understanding of how, and why performance is good.

Online resources

- The Improvement Academy Website: www.improvementacademy.org/.
- HSE incident management website: www.hse.ie/eng/about/qavd/incident-management/.
- HSE Quality Improvement Knowledge and Skills Guide: www.qualityimprovement.ie.
- UK Healthcare Safety Investigation Branch: www.hsib.org.uk/.

Additional readings

- Gupta, K.J. & Cook, T.M. (2013). Accidental hypoglycaemia caused by an arterial flush drug error: a case report and contributory causes analysis. *Anaesthesia,* 68, 1179-1187. doi.org/10.1111/anae.12388.
- Health Services Executive (2020). Incident Management Framework. Available from: www.hse.ie/eng/about/qavd/incident-management/hse-2020-incident-management-framework-guidance.pdf (the Yorkshire Contributory Factors Framework is discussed in section 13).
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Chapter 11.
Examples of human factors interventions

Introduction

This final chapter will discuss examples of human factors interventions. An example intervention will be presented for each level of the sociotechnical systems model that was used as the structure of this guide (i.e. patient/service user, the work environment, individual healthcare worker, healthcare teams, organisation and management, and society, culture and regulatory influences). The examples of interventions provided are certainly not exhaustive. However, they provide an overview of a range of different approaches to addressing human factors issues in healthcare organisations.

We often have intuitive ideas about what changes might improve a situation in the workplace. However, when targeted changes impact patient safety, it is important that we take action on the basis of the best available evidence, test changes before rolling them out widely, and have a clear goal for what we want to achieve.

There are many models of Quality Improvement (QI) that can support a systematic approach to identifying and addressing human factors issues. However, an increasingly commonly used approach is the model for improvement that is proposed by the Institute for Healthcare Improvement (IHI) [1]. The model for improvement begins with three key questions:

1. What are we trying to accomplish?
2. How will we know that a change is an improvement?
3. What change can we make that will result in improvement?

With these three questions in mind, the model for improvement presents an improvement cycle that the improvement process can be structured around. The Plan, Do, Study, and Act (PDSA) cycle provides a structure for the process of planning, implementing and evaluating the intervention (see

the figure below). Using this structure, small changes made to the system are tested and refined based on learning gained from each cycle, and eventually scaled up. The four stages of the PDSA cycle align with the experimental method of developing a hypothesis (plan), implementing an intervention or change to effect an outcome (do), collecting data to test the effects of the change on the outcome (study) and analysing the data in order to make inferences to allow change to be made to the hypothesis (act)[1]. Unlike the experimental method, the PDSA cycle for quality improvement supports the *rapid* assessment of an intervention and provides flexibility to quickly make changes based upon feedback.

Adapted from ACT Academy NHS Improvement [2]
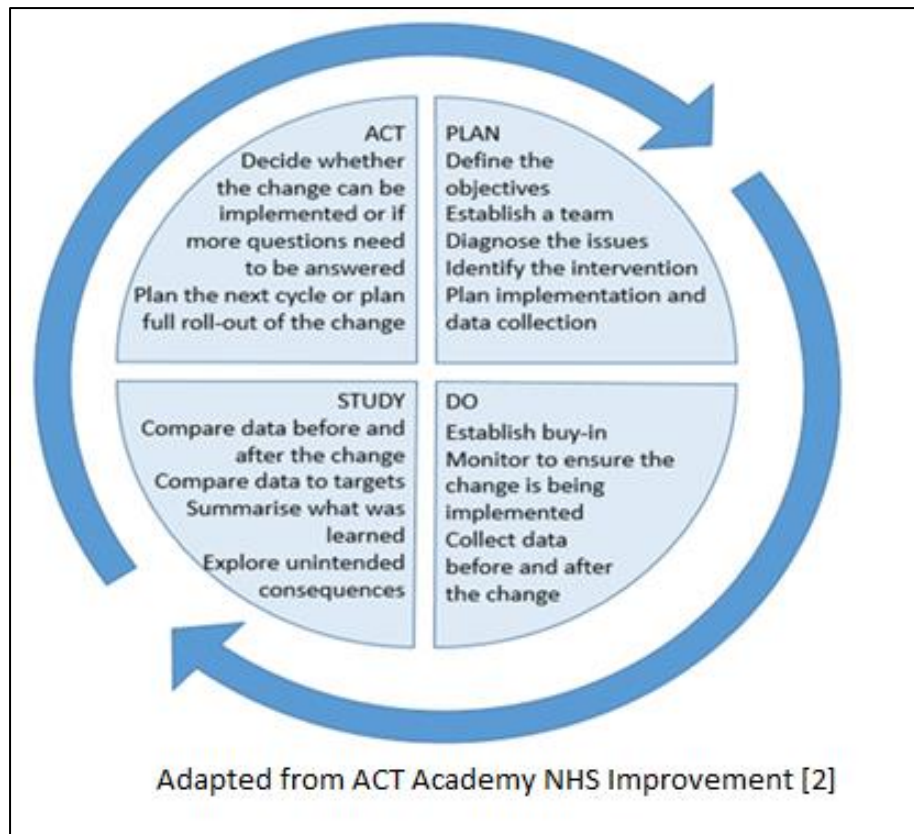
Why should I read this chapter?

Healthcare workers should read this chapter because it provides examples of how they can become involved in developing and/or supporting human factors interventions.

Level 1: Patient/service user

Always events

The Institute for Healthcare Improvement defines always events as aspects of the patient and family experience that should always occur when patients/service users interact with healthcare professionals and the healthcare delivery system [3]. An always event should meet four criteria:

1. **Important**: Patients/service users or family members (<u>not</u> healthcare workers) have identified an event as crucial to improving their experience of care, and believe that the event will have a meaningful impact on quality of care.
2. **Evidence-based**: There is evidence (either through research or quality improvement measurement) that an event contributes to quality of care and respect for patients/service users.
3. **Measurable**: The event is specific, well defined, and quantifiable so that it can be determined whether or not the event has occurred.
4. **Affordable and sustainable**: The event should be achievable and sustainable without substantial renovations, capital expenditures, or the purchase of new equipment or technology. This specification encourages organisations to focus on leveraging opportunities to improve the care experience through improvements in relationship-based care and in care processes [4].

An example of the application of this approach was to identify what homeless patients/service users always want to happen when they visit the GP [4]. Twenty patients/service users attending three drop-in clinics at a specialist homeless general practitioner service in Glasgow were asked: 'what is so important to you that it should always happen when you visit this GP surgery?' Of the responses, five were deemed to be always events. The respondents always wanted:

- to be seen;
- for the staff to be approachable and responsive;
- to feel safe while waiting to be seen;
- for their privacy to be valued; and
- to have clear information on how the service works [4].

Now that the issues have been identified, the service can then identify which of these issues they wish to address in any quality improvement initiative.

Further resources

- Institute for Healthcare Improvement (2016). *Always Event Toolkit*. Available from: www.ihi.org/resources/Pages/Tools/Always-Events-Toolkit.aspx
- McCallum, et al. (2019). Using Always Events to derive patient-centred quality improvement priorities in a specialist primary care service providing care to a homeless population. *BMJ Open Quality*, *8*, e000507. dx.doi.org/10.1136/bmjoq-2018-000507.
- HSeLanD - Introduction to Quality Improvement e-learning resources.

Level 2: Equipment/work environment

Human reliability analysis and standardisation

One approach to managing safety in high-risk industries, such as nuclear power generation and aviation, is to achieve a high level of standardisation in how tasks are performed. One of the methods

used to achieve standardisation is human reliability analysis. Human reliability analysis consists of a range of techniques and approaches to systematically identify the impact of human variability on a system [5].

A specific human reliability technique used to identify how people preform a specific procedure is called a task analysis. A task analysis breaks a task down into the component steps that must be carried out in order to complete the task. Task analyses are used to examine how people interact with equipment and their working environment [6].

Example task analysis: Endotracheal suctioning [6]

	Task	Plan
1	**Prepare the patient**	*In all cases do 1.1-1.3; optionally do 1.4-1.6 - if using a closed-suction system, 1.4-1.5 can be done concurrently while performing suctioning.*
1.1	Perform hand hygiene	
1.2	Place a pulse oximeter on the patient	
1.3	Hyperoxygenate the patient	
1.4	Hyperventilate the patient	
1.5	Hyperinflate the patient's lungs	
1.6	Instil sterile normal saline through the artificial airway to mobilize secretions (perform lavage)	
2	**Perform suctioning**	*In most cases do one of 2.1-2.2 - if the patient requires a high inspired oxygen concentration or high positive end-expiratory pressure do not do 2.1; do 2.2.*
2.1	Use a single-use disposable suction catheter	*Do in sequence 2.1.1-2.1.6.*
2.1.1	Perform hand hygiene and apply gloves	
2.1.2	Prepare the suction catheter	
2.1.3	Insert the suction catheter through the artificial airway into the trachea	
2.1.4	Apply negative pressure while withdrawing the suction catheter and stabilizing the artificial airway with the opposite hand	
2.1.5	Discard the suction catheter in medical waste	
2.1.6	Remove gloves and perform hand hygiene	
2.2	Use a multi-use closed suction system	*If a closed suction system is not attached to the breathing circuit do in sequence 2.1.1-2.1.5 - if a closed suction system is already attached to the breathing circuit do 2.2.1 do not do 2.2.2; do in sequence 2.2.3-2.2.5.*
2.2.1	Perform hand hygiene and apply gloves	
2.2.2	Prepare and attach the closed suction system	
2.2.3	Advance the closed suction catheter through the artificial airway into the trachea	

Example task analysis continued.

2.2.4	Withdraw the suction catheter until the tip is out of the artificial airway and secretions have been aspirated	
2.2.5	Remove gloves and perform hand hygiene	
3	**Perform follow-up care**	*Do 3.1-3.2; optionally do 3.3; do 3.5.*
3.1	Hyperoxygenate the patient	
3.2	Monitor the patient for adverse reactions	
3.3	Hyperventilate the patient	
3.5	Perform hand hygiene	

It is important to indicate that, in healthcare, the goal of a task analysis is to identify '*a correct way*' of performing the task as there is unlikely to be only one single '*correct way*' to perform a procedure. Task analysis is a very useful tool for the human factors practitioner. The output can be used to write procedures and protocols to help standardise care delivery, to audit and provide feedback on task performance, for education (see the precision teaching example below), as part of a process and quality improvement intervention, or to help to identify needed improvements in the design of medical devices. Links to training videos that are based on task analyses are provided below.

Examples of training videos for procedures based on task analyses

- Bronchoscope assisted Percutaneous Dilation Tracheostomy: www.youtube.com/watch?v=nvvLE-BimC4.
- Endotracheal suctioning in critically Ill adults: www.youtube.com/watch?v=KdUAJ-nDjDg.
- Rapid sequence intubation outside of the operating theatre: www.youtube.com/watch?v=6fphsFMmPkM.
- Ultrasound-guided right internal jugular vein central venous cannulation: www.youtube.com/watch?v=-X05DgCfQrE.

Further resources

- Corbett, M., et al. (2019). Identifying and reducing risks in functional endoscopic sinus surgery through a hierarchical task analysis. *Laryngoscope Investigative Otolaryngology*, 4, 5-12. doi.org/10.1002/lio2.220.
- Lavelle, A., et al. (2020). Human reliability analysis of bronchoscope assisted percutaneous dilatational tracheostomy: implications for simulation based education. *Advances in Simulation,* 5, 30. doi.org/10.1186/s41077-020-00149-7.
- Reddy, K., et al. (2020). The application of human reliability analysis to three critical care procedures. *Reliability Engineering and System Safety*, 203, 107-116. doi.org/10.1016/j.ress.2020.107116.

Level 3: Individual healthcare worker

Precision teaching

Precision teaching is a particular approach to learning how to perform a technical procedure. This approach goes beyond the usual level of training used in healthcare, as the goal of precision teaching is to reach fluency in a procedure. Someone can be considered to be fluent in a procedure when they can complete the steps of the procedure correctly, and in a similar time to an expert. An intervention incorporating precision teaching typically includes:

1. the establishment of a fluency criterion (i.e., a time in which an expert can comfortably and accurately complete the task);
2. frequency building (i.e., repeated, timed learning trials during which the learner performs the procedure and receives feedback);
3. an assessment of whether a growth in learning is occurring or whether a change in instructional tactics is required; and
4. changing, or supplementing, instructional tactics in instances where a learner is not progressing [7].

A training intervention based on a precision teaching approach was used to teach newly graduated medical students how to order blood products [8]. As part of a 'boot camp' training course given prior to internship, a total of 27 newly graduated medical students were given three hours of hemovigilance training and additional repetitive practice opportunities throughout the remainder of the three week boot camp training. On commencement of their internship, the errors made in requesting blood products (in the real clinical environment) by the 27 'trained' interns was compared with the errors made by a group of 30 'untrained' interns across the first 13 weeks that they were working in the hospital. The precision teaching training intervention was found to reduce the risk of a rejected sample by 65% as compared with interns who did not receive the training. Moreover, the risk of a rejected sample for trained interns was 45% lower than for more experienced doctors. The untrained interns required more than two months of clinical experience to reach an error rate of the trained interns.

Adapted from Joyce et al (2015)
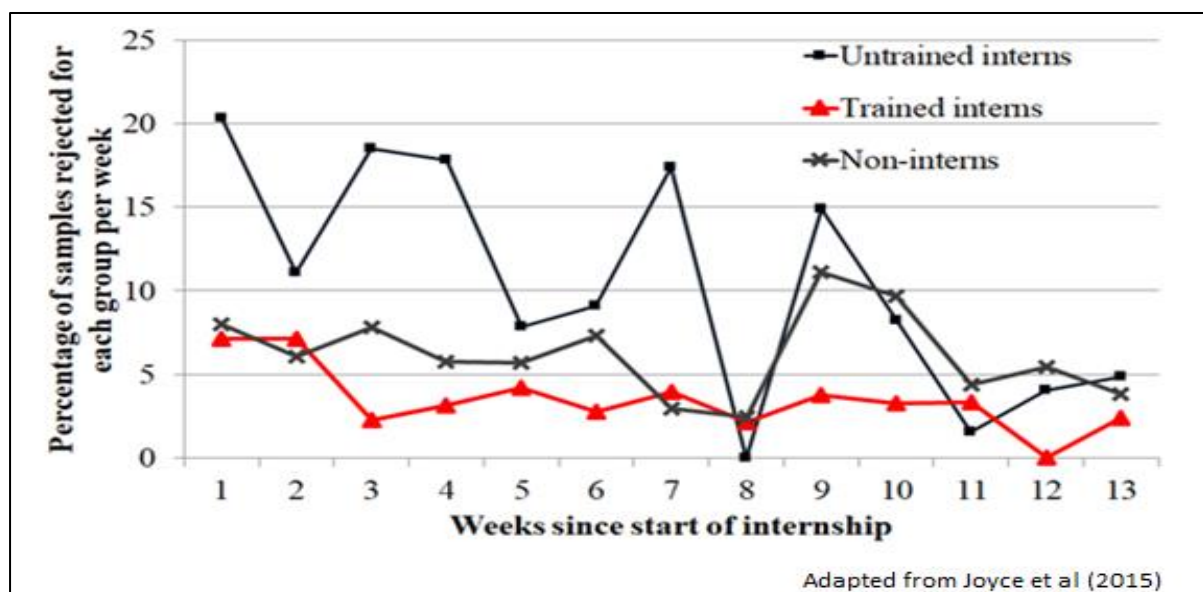
Further resources

- Joyce, K., et al. (2015). An evaluation of the use of deliberate practice and simulation to train interns in requesting blood products. *Simulation in Healthcare*, 10(2), 92-97. doi.org/10.1097/SIH.0000000000000070.
- Lydon, S., et al. (2019). Can simulation-based education and precision teaching improve paediatric trainees' behavioural fluency in performing lumbar puncture? A pilot study *BMC Medical Education*, 19, 138. doi.org/10.1186/s12909-019-1553-7.
- Reid-McDermott, B., et al. (2019). Using simulation to explore the impact of device design on the learning and performance of peripheral intravenous cannulation. *Advances in Simulation*, 4, 27. doi.org/10.1186/s41077-019-0118-5.

Level 4: Healthcare team

Team training

There is a large amount of evidence to support the effectiveness of team training in improving the performance of healthcare teams [9]. One of the most rigorously evaluated, and widely applied, approach to team training in healthcare, is the Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) training intervention [10]. Developed by the U.S. Agency for Healthcare Research and Quality and the U.S. Department of Defence, this training is founded upon the Crew Resource Management model of team training that is used in aviation. In the U.S., TeamSTEPPS is supported by a national network of training centres as well as the availability of online training material, evaluation tools, and national conferences. As a result of the positive findings of the effectiveness of TeamSTEPPS, it is now increasingly being used outside of the U.S.

TeamSTEPPS is a set of strategies and tools aimed at ensuring reliability and patient safety through effective team performance. The training covers four nontechnical skills: communication; leadership; situation monitoring; and mutual support [10]. It is also important to note that the people delivering the training (called Master trainers) have been instructed in how to deliver the training, but are also healthcare workers from the organisation/unit that is engaging in the training. The TeamSTEPPS intervention has three phases [10].

Phase 1: Assessment. The purpose of this phase is to determine the readiness of the organisation/unit to implement the TeamSTEPPS intervention. A multi-disciplinary change team is established. This team identifies an opportunity for improvement using TeamSTEPPS concepts, tools, and strategies.

Phase 2: Planning, training, and implementation. This phase involves developing an action plan that details what the organisation or unit intends to do during the intervention. This plan should be developed in collaboration with the healthcare workers in the organisation/unit. The Master trainers then train the members of the organisation/unit and support them to meet the goals set out in the action plan.

Phase 3: Sustainment: The goal of the final phase is to sustain and spread any improvements resulting from the TeamSTEPPS intervention. An approach for continuous improvement should be developed, and the initiative should be expanded to other areas of the organisation that were have not yet been involved in the initiative.

TeamSTEPPS has been shown to have a positive impact on team performance [11], clinical processes [12], clinical outcomes [13], and safety culture [14]. The success of the TeamSTEPPS programme can be attributed to: (1) the free availability of high quality training materials; (2) the fact that the healthcare workers themselves are invested in the process (i.e. rather than getting external trainers deliver the training, and then leave); and (3) the ability of members of the unit/organisation to focus on the areas that they believe need to be addressed.

Further resources

- A large amount of resources on TeamSTEPPS are available here: www.ahrq.gov/teamstepps/index.html.

Level 5: Organisation

Reducing overuse in healthcare

Overuse in health care (also described as waste or over-treatment) occurs when medical tests and procedures are used despite the fact that they have little benefit in the particular clinical context. Appropriate use of a procedure or test occurs when: (1) there is support from evidence; (2) it is truly necessary; (3) it is not duplicated by previously completed tests or procedures; and (4) it is as free from harm as possible. In Ireland, laboratory diagnostics account for up to 9% of typical hospital budgets [15]. It has also been found that up to 30% of all medical care adds no value to patients/service users, and in fact can lead to harm [16]. Yet, overuse persists as both healthcare workers and patients/service users are victims of the 'therapeutic illusion' [15].

A quality improvement project was carried out in Tallaght hospital. Although not specifically described as a human factors intervention, it could be considered to be such. This quality improvement project used a sensible test ordering practice (STOP) called "S.T.O.P. and think!" This approach used a three-tiered traffic light systems for ordering tests. Those tests defined as 'green' could be ordered by junior staff (e.g. interns). More complex or expensive tests in 'amber', and 'red' tiers required escalation to increasingly senior staff (e.g., registrars or consultants) before the test could be ordered. In four months there was a 50% reduction in coagulation screens, 98% reduction in blood glucose tests, and significant reductions in several other pathology tests in the Emergency Department. These changes resulted in a saving of 94,500 Euro per annum [16].

Further resources

- Boran, G.S. et al. (2014). *Sensible Test Ordering Practice in an Emergency Department*. Available from: www.hse.ie/eng/services/publications/clinical-strategy-and-programmes/sensible-test-ordering-practice-in-an-emergency-department.pdf
- Brownlee. S, et al. (2017) Evidence for overuse of medical services around the world. *Lancet*, 390, 156-68. doi.org/10.1016/S0140-6736(16)32585-5.
- HSE. (2018). *People's Needs Defining Change: Health Services Change Guide*. Dublin: Author. Available from: www.hse.ie/eng/staff/resources/changeguide/resources/change-guide.pdf

Level 6: Regulatory environment

Healthcare regulation and human systems integration

There are several examples of human factors principles influencing healthcare regulation. A prime example is the European Working Time Directive (EWTD)[17] which is based on an acknowledgement of the negative impact of long working hours on workers' health and wellbeing. The legislation was widely welcomed by medical profession as a positive step towards achieving a better work-life balance. However the legislation is not without controversy and there have been concerns about the implications on continuity of care, staffing levels, and a reduction in training time. Additionally there is evidence of variable compliance to the EWTD across hospitals and between specialties. Many of these consequences were identified and taken into account by the Irish government in their implementation of the EWTD into the Irish health service. Nevertheless, this is a prime example of the need to continually measure the intended and unintended consequences of change on the health care system. Both process (the way the work is done) and outcome (patient health and safety) measures should be used to test the impact on the system when such changes are introduced. Examples of other regulation that are influenced by human factors principles are:

- **Open disclosure policy**. This policy is based on the principle that patients/service users have the right to full knowledge about their healthcare and to be informed when things go wrong during their health care journey [18].
- **The assisted decision making act**. This act maximises a person's right to make their own decisions, with legally recognised supports, whenever possible [19].
- **The HSE incident management framework.** This policy and framework seeks to ensure a person-centred response to the management of safety incidents. Particular emphasis is placed on supporting the needs of service users, families, and staff in the aftermath of an incident [20].

Another interesting example of a more comprehensive regulatory approach to human factors is Human Systems Integration (HSI). First conceived by the U.S. Department of Defence, HSI prioritises human considerations in systems design from the very beginning of the design process [21]. Considering how the human fits in the system can reduce the cost of running the system, and increase

the efficiency, usability, and quality of the system. HSI is a multidisciplinary field of study consisting of seven domains [22]:

1. **Human factors engineering**- the human-user considerations in the design of the system hardware and software (a particularly narrow view of human factors).
2. **System safety**- systems design considerations to minimise the risk of accidents.
3. **Health hazards**- hazards to health (short and long-term) that can occur as a result of operating the system.
4. **Personnel survivability**- features of the system that impact the potential for injury to the user.
5. **Manpower**- the number, type of personnel, and expertise required to use the system.
6. **Personnel**- the knowledge, skills, and abilities required to use the system.
7. **Training**- the training required to use the system.
8. **Habitability**- the living and working conditions of the system (e.g. lighting, noise).

These seven HSI domains could be considered within the context of a single medical device (e.g. patient monitor), or an entire hospital. One of the interesting considerations is the 'trade-offs' and balances across these different domains. To illustrate, it may be preferable to spend more money on the upfront cost of an automated system because this saves money later as it requires less qualified personnel with less training to use the system than would have been the case for a system with less automation.

Further resources

- National Aeronautics and Space Administration (2015). *Human Systems Integration Practitioner's Guide*. NASA/SP-2015-3709. Houston: Johnson Space Centre. Available from: ntrs.nasa.gov/api/citations/20150022283/downloads/20150022283.pdf?attachment=true.

Conclusion

Human factors interventions have the potential to improve safety, quality, and efficiency in the healthcare industry. Human factors practitioners use a wide range of theories, measures, and approaches in order to improve the safety, quality and efficiency of workplaces; the appropriate strategy and approach will depend on the problem situation and the context. It is important to note that human factors solutions rely on a thorough understanding of the problem situation before solutions are developed, and solutions are tailored to meet the needs of the situation and the context. Moreover, it is important that a structured approach is taken to identifying a human factors issue, and developing and implementing a solution. It is also crucial to ensure that the healthcare workers in the organisation in which the intervention is to be applied are invested in the process.

Practical implications

- It is possible to identify and address human factors issues in healthcare organisations.
- It is recommended that human factors interventions are designed, developed, implemented, and evaluated using a quality improvement model.
- It is important that healthcare workers are involved in the identification and implementation of human factors interventions, rather than have interventions 'imposed' upon them.

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14. Staines, A., et al. (2020). Impact of TeamSTEPPS on patient safety culture in a Swiss maternity ward, *International Journal for Quality in Health Care*, 32, 618-662

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16. Boran, G.S. et al. (2014). *Sensible Test Ordering Practice in an Emergency Department*. Available from: www.hse.ie/eng/services/publications/clinical-strategy-and-programmes/sensible-test-ordering-practice-in-an-emergency-department.pdf

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