Human Factors Influencing Safe Medication Use

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What I will cover:

• Describe Human Factors.
• How Human Factors apply to healthcare.
• The Human Factors involved in medication safety.
• Human Factors in the primary care setting and how this can affect medication safety.
Medication Safety

3/4 of New Zealanders are estimated to have had a prescription for one or more medicines in the year ended 30 June 2013.¹

Up to 60% of adverse drug events (ADEs) are thought to be preventable.² Medication errors and adverse drug reactions (ADRs) are the main causes of ADEs.

Frequency of ADEs

- 13% with two medicines
- 58% with five medicines
- 82% with seven or more³

Up to $158m is the estimated annual cost of preventable ADEs in New Zealand.⁴

Between July 2007 and June 2013:

- 2159 reported serious adverse events
  - 132 medication events
    - 23 related to opioids
    - 19 related to anticoagulants
    - 7 related to insulin⁴

¹ Extrapolation based on PHARMAC Annual report 2012/2013.
³ Patterson L et al, interventions to improve the appropriate use of polypharmacy for older people. Cochrane Database of Systematic Reviews 2012, issue 1.
High-risk Medicines

Factors that increase high-risk medicine’s potential for harm include:

• Narrow therapeutic index
• Complex or unusual dosing
• Monitoring requirements
• Interactions with other medicines, foods etc.
• Multiple strengths and forms
• Look-alike, sound-alike naming and packaging
Human Factors

Describes how we function, as normal healthy humans, on a daily basis. This involves several key areas:

• Cognition: traditionally referred to as Human Factors
• Physical interaction: known as either Human Factors or Ergonomics
Cognition

• A set of mental processes involved in encoding, transforming, storing, and retrieving information
• These processes include attention, memory, language, reasoning, decision making and learning.

So, how does the brain process information?
The Classic Cognitive Psychology Account of Information Processing

- INFORMATION RECEIVED BY THE SENSES
- ATTENTION
- PERCEPTION
- MEMORY
  - SHORT-TERM MEMORY
  - LONG-TERM MEMORY
- DECISION MAKING AND RESPONSE SELECTION
- OUTPUT
Attention

• We select relevant or important information for enhanced or deeper processing
• The brain’s processing is limited
• Not everything is selected by attention
• We are not always consciously aware of other information
Capacity Theory of Attention

- Daniel Kahneman (1973) single resource model
- Attention is limited by ‘processing resources’, the amount of which vary according to arousal level

High arousal & poor feedback = action slips

Arousal

Enduring Dispositions

Attention allocation

Feedback

Task demands
Action Slips and Errors in Healthcare

The professional cultures of medicine and nursing typically use blame to encourage proper performance. Errors are caused by a lack of sufficient attention or, worse, lack of caring enough to make sure you are correct.

(Lucian Leape, 1994)
Action slips and Errors in Healthcare

• Many errors are beyond individual’s conscious control.
• Errors are precipitated by a range of factors
• For physicians, nurses, and pharmacists to succeed in reducing errors in health care requires a change in the way they think about errors.

(Lucian Leape, 1994)
James Reason
Swiss Cheese Model for Error
Medication Errors: Definitions

1. Adverse events that are not reactions to a medicine
2. Adverse drug reactions (ADRs) (not from errors)
3. ADRs (from medication errors)
4. Medication errors that cause events that are not ADRs
5. Medication errors that don’t cause adverse events

- A medication
- An error
- A medication error
- Prescribing faults
- Prescription errors
- Balanced prescribing

Medication Errors: Definitions

• A medication: covers a wide range of compounds; usually a drug or a prodrug.

• An error: something incorrectly done through ignorance or inadvertance; a mistake, e.g. in calculation, judgement, speech, writing, action etc.

Aronson, 2009
Medication Errors: Definitions

• A medication error: ‘a failure in the treatment process that leads to or has the potential to lead to, harm to the patient’

‘failure’: the process has fallen below an attainable standard
‘treatment process’ includes treatment of symptoms and also disease
‘harm’ also implies ‘lack of benefit’

Aronson, 2009
Medication Errors: Definitions

- Prescribing faults: irrational prescribing, inappropriate prescribing, underprescribing, overprescribing or ineffective prescribing

- Prescription errors: ‘a failure in the prescription writing process that results in a wrong instruction about one or more of the normal features of a prescription’ The ‘normal features’ include identity of recipient, identity of drug, formulation and dose, route, timing, frequency, duration etc.

Aronson, 2009
Medication Errors: Definitions

• Balanced prescribing: ‘the use of a medication that is appropriate to the patient’s condition and, within the limits created by the uncertainty that attends therapeutic decisions, in a dosing regimen that optimizes the balance of benefit to harm’

This excludes all forms of prescribing faults

Aronson, 2009
Medication Safety and Where the Risks Occur

- Consultation
- Prescription
- Transcribing
- Dispensing
- Administration

The concept of medication safety must look at the opportunity for errors to occur at any one of these steps.
Medication Safety and Where the Risks Occur in Hospitals

![Bar chart showingrisks in medication safety across different stages:

- Prescribing: Highest risk (close to 60%)
- Transcribing: Moderate risk
- Dispensing: Low risk
- Administration: Moderate risk]
Dispensing Errors: orthographic (look-alike) and phonographic (sound-alike) names

- Pergolide (Permax®) for perhexiline (Pexsig®)
- Trimipramine (Tripress®) for trimethoprim (Triprim®)
- Tenoxicam (Tilcotil®) for tamoxifen (Genox®)

HDC Cases 02HDC04619, 03HDC08821, 13HDC01235
Human Factors in Primary Care that Affect Medication Safety

- Communication with patients
- What patients understand about their medication
- Some specific issues around medication safety from a human factors perspective
Communication

• “about 55 percent of the elderly do not comply with medication regimens”
• “The reluctance of physicians and pharmacists to provide information about the risks of drugs accentuates the problem”

David Kessler (FDA), 1991
How patients want their doctor to communicate

• There has been considerable research into this area.
• Quantitative, qualitative and mixed research methods relate to the function of “Fostering the Relationship”

Deledda et al, 2012
Quality of information given to patients

Asking three questions:
• What are my options?
• What are the benefits and harms?
• How likely are these?

These can drive:
• Evidence-based practice
• Strengthen patient-physician communication
• Improve safety and quality

Shepherd et al, 2011
Human Factors in Medication Safety in the Real World

What happens when a patient leaves with a prescription?

• It is a jungle: there are traps
• Complex and individual systems
• Psycho-social interactions
Medication Returns

• Five week period to two Otago pharmacies
• 163 returns

Figure 2. Age distribution of respondents

Braund et al, 2008
Medication Returns

Figure 3. Reasons for unused medication

Braund et al, 2008
Medication Knowledge and Adherence

• Direct relationship between reported adherence to medication regimen and professed knowledge of medication

• Linked to education, age and medication duration

• One quarter unaware of long term benefits of medication

Okuyan et al, 2013
Communication with the Older Polymedicated Patient

• Interviews with patients older than 65 years
• 75% reported at least one error in previous year, 16% four or more and 5% had very severe consequences
• Concerns: dosage, appearance, lack of understanding of instructions

Mira et al, 2013
The number of drug classes dispensed (a) and potentially serious drug-drug interactions (b) by age of patient (data from 2010).

Polypharmacy and Drug-Drug Interactions

- “guidelines … recommend multiple drug therapy to achieve tight intermediate outcomes”
- “polypharmacy is potentially problematic rather than always inappropriate, because potentially serious interactions do not always cause harm or may be a price worth paying for benefits”
- “most evidence of effectiveness is from randomised trials which usually exclude older people and those with multimorbidity and polypharmacy”

Benefit, Harm and Uncertainty

How can you make decisions around the benefits and the harms when you are uncertain of any possible outcome?
Estimating Benefit and Harm in Treatments, Tests and Screening

“Participants [the public] rarely had accurate expectations of benefits and harms, and for many interventions, regardless of whether a treatment, test, or screen, they had a tendency to overestimate its benefits and underestimate its harms”

Hoffman, TC & Del Mar, C (2015) Patients’ expectations of the benefits and harms of treatments, screening, and tests. JAMA 175: 274-286
“Clinicians themselves may have overly optimistic expectations about the benefits of interventions and poor knowledge of harms and may oversell interventions when offering them to patients.”

Hoffman, TC & Del Mar, C (2015)
Professionalism and Cognitive Dissonance

“Professionalism may help to avoid intentional corruption, but cannot reduce unintentional subconscious bias.”

There are other factors:

• Believing biased information
• Self-serving biases
• Sense of entitlement
• Principles of influence: reciprocity, commitment & consistency, social proof, liking, authority & scarcity - key opinion leaders

Making Rational Decisions
The Certainty Principle

Would you prefer-

A. 50% chance to win a 3-week tour of England, France, and Italy
B. (100% certain) 1-week tour of England

C. 5% chance to win a 3-week tour of England, France, and Italy
D. 10% chance to win a 1-week tour of England

The majority of people will pick B over A, but choose C over D.

Judgment and Choice

We have two modes of cognitive functioning:

• **System 1.** Complex judgments and preferences come to mind quickly and effortlessly. This can be called intuition.

• **System 2.** Computes judgments and also continuously monitors and overrides tentative judgments.

Making Judgment and Choice

1. An intuitive judgment is initiated, and
   a) Endorsed by System 2;
   b) Adjusted for other recognised features
   c) Corrected for recognised bias; or
   d) Identified as violating a rule

2. No intuitive response comes to mind, and
   the judgment is computed by System 2.

Making Judgment and Choice

A bat and a ball cost $1.10
The bat costs one dollar more than the ball
How much does the ball cost?
The number that most likely comes to mind is 10 cents.
This is intuitive, appealing, and wrong.
(The correct answer is 5 cents)

Framing Outcomes: Problem One

Imagine that you have decided to see a play where the admission is $10 per ticket. As you enter the theatre you discover that you have lost a $10 bill.

Would you still pay $10 for a ticket for the play?

Yes [88%]  
No [12%]

Imagine that you have decided to see a play and paid the admission is $10 per ticket. As you enter the theatre you discover that you have lost the ticket. The seat was not marked and the ticket cannot be recovered.

Would you pay $10 for another ticket?

Yes [46%]  No  [54%]

1. S-shape curve represents diminishing sensitivity for gains and losses
2. Curves are not symmetrical: response to losses is stronger than response to gains

Certain or Uncertain, Loss or Gain

Subjective Value (proportion)

Certain loss-uncertain gain

Certain gain-uncertain loss

Making Decisions in Uncertainty

- When testing decisions around financial gains and losses, we under value gains and over value losses.
- This contrasts with patients’ or clinicians’ overestimation of benefits (i.e. gains) and underestimation of harms (i.e. losses) with treatments, screening and tests.
- The manner in which we make decisions that rely on uncertainty is affected by the framing of choices and outcomes.
Making Decisions About Statins

• “Whether or not the overall benefit-harm balance justifies the use of a medication for an individual patient cannot be determined by …. the attending physician”

• “Instead, it is the individual patient who has a fundamental right to decide whether or not taking a drug is worthwhile”

• “Researchers and professional organizations should endeavor to develop shared decision-making tools that provide up-to-date best evidence in easily understandable formats, so as to assist clinicians in helping their patients to make the decisions that are right for them”

The Certainty and Uncertainty About Statins

- Explored the role of risk and uncertainty in accounts of medication decisions through patient interviews
- “very few participants mentioned risk or likelihood, or described weighing benefits against harms”
- “those who had decided to take statins described their certainty that statins were needed to treat current problems”
- “those who had decided not to take statins explained their decisions in terms of the inherent uncertainty of information about the future”

A heart attack occurs when blood flow to the heart is interrupted, and a stroke occurs when
blood flow to the brain is interrupted. The resultant damage from either can be fatal or non-
fatal.

Imagine you are 1 of a 100 people who are of similar age and lifestyle habits. If this group of
100 people is given no treatment to prevent a heart attack or a stroke for 5 years, some will
experience a heart attack or stroke and some will not. You are one of these 100 people, but
you have no idea as to whether you will experience either of these medical conditions. A new
Drug X is available on the market, and if 100 people like you were to take Drug X every day
for 5 years, the number who will experience a heart attack or a stroke will decrease.
However, all 100 will experience a side effect for the duration of the time they take the
drug.

Below is additional information on the properties of Drug X. Please read each offer carefully,
as each will be slightly different from the previous, and answer the question below.
Finds the smallest benefit a drug must provide to tolerate its side effect. The side effect is either “frequent headache” or “cold hands and feet”
### Sample questions

| Number of people who will experience a heart attack or a stroke within 5 years if left untreated: | 15 out of 100 |
| Number of people who will experience a heart attack or a stroke within 5 years while on Drug X: | 8 out of 100 |
| Side effect while on Drug X for 5 years: | Frequent headaches |

What would you do?

<table>
<thead>
<tr>
<th>Take the drug</th>
<th>Do not take the drug</th>
</tr>
</thead>
</table>

| Number of people who will experience a heart attack or a stroke within 5 years if left untreated: | 30 out of 100 |
| Number of people who will experience a heart attack or a stroke within 5 years while on Drug X: | 15 out of 100 |
| Side effect while on Drug X for 5 years: | Frequent headaches |

What would you do?

<table>
<thead>
<tr>
<th>Take the drug</th>
<th>Do not take the drug</th>
</tr>
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</table>
Pilot Study Results

Participant sensitive to side-effect severity

Participant not sensitive to side-effect severity

The higher the points are (on the y-axis), the more benefit required for taking medication.
Pilot Study Results

• Have any of your close family members had a heart attack or stroke?
  – Sensitive to side-effect severity (9/14)
    • 7 reported no family history of heart attack / stroke
    • 2 reported family history of heart attack / stroke
  – Not sensitive to side-effect severity (5/14)
    • 5 reported family history of heart attack / stroke
Questions?