Standardising on-screen clinical medicines information for safety

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Human factors contribution to standardising on-screen display of medicines information to promote their safe and quality use

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Overview of presentation

- Australian Commission on Safety and Quality in Health Care
- Standardised medicines terminology, eMM and consumers
- Guidelines for on-screen presentation of medicines information
- Consultation, feedback and unresolved issues
- Human factors and electronic medication management
- Partial task analysis and heuristic evaluation of unresolved issues
- Recommendations for the guidelines
Partnering with patients, consumers, community
Supporting health professionals provide safe high-quality care
Patient safety
Quality, cost and value
AUSTRALIAN COMMISSION ON SAFETY AND QUALITY IN HEALTH CARE
Medicines and patient centred care
Electronic medication management (eMM) and quality use of medicines

• Relay prescriber’s intention via several clinical processes through to patient administration
• Clear and unambiguous medicines information in electronic medicines recording and management systems
• Standardised medicines information has the potential to reduce medication errors and minimise patient harm
• Problematic presentation of data on screen may contribute to new types of errors
• Human factors play an important role in determining a preferred solution.
National Guidelines
for On-Screen Display
of Clinical Medicines Information

January 2016

AUSTRALIAN COMMISSION
ON SAFETY AND QUALITY IN HEALTH CARE
Developing national guidelines for medicines information

Draft guidelines for standardised, consistent on-screen display of clinical medicines information based on

- Best practice principles for clinical user interface design
- Common User Interface (CUI) Clinical Applications and Patient Safety Programme, National Health Service and Microsoft Health and Social Care Information Centre, UK
- Design for patient safety: guidelines for safe on-screen display of medication information National Health Service, 2010
- Literature review and international perspective
- National Recommendations for Terminology and Symbols used in the Prescribing and Administration of Medicines

Safer presentation of medicines

Institute for Safe Medication Practices (ISMP) June 5, 2014

Misidentification of alphanumeric symbols

Clarity allows reader to focus on message, use

• **Visibility** – quality of alphanumeric symbol that makes it separately discernible from surroundings

• **Legibility** – attribute that makes the character recognisable

• **Readability** – quality that enables recognition of the information content of material
Electronic medication errors in the literature


- Reduction in medication errors in hospitals due to adoption of computerized provider order entry systems. Radley DC, Wasserman MR, Olsho LE, Shoemaker SJ, Spranca MD, Bradshaw BJ. Am Med Inform Assoc. 2013 May 1;20(3):470-6

Recommendations for Terminology, Abbreviations and Symbols used in the Prescribing and Administration of Medicines

Introduction

One of the major causes of medication errors is the ongoing use of potentially dangerous abbreviations and dose expressions.\(^1\) This is a critical patient safety issue. A study to identify and quantify prescribing errors in a large US urban teaching hospital found that 29% of prescriptions contained a dangerous abbreviation.\(^2\) An abbreviation used by a prescriber may mean something quite different to the person interpreting the prescription. Abbreviations may not only be misunderstood but can also be combined with other words or numerals to appear as something altogether unintended.

In addition, there have been changes to training of health care professionals, to health care delivery and to societal expectations, which also necessitate a rethinking of the language used to communicate medication prescribing and administration. Latin was once the language of health care and its use made medical literature universally readable among educated persons.\(^3\) Today, English is the predominant language of medical literature.\(^3\) Despite this, Latin abbreviations continue to be used amongst health professionals. Although this may be a timesaving convenience, their routine training in terms used for the administration of medicines. In addition, patients and their carers have the right to understand what is being prescribed and administered to them. Prescribing using codes or an outdated language is no longer acceptable.

Objectives

In order to promote patient safety and clear and unambiguous prescribing of medicines, this document establishes the following:

- **Principles for consistent prescribing terminology** (Table 1)
- **A set of recommended terms and acceptable abbreviations** (Table 2)
- **A list of error-prone abbreviations, symbols and dose designations that have a history of causing error and must be avoided** (Table 3)

Scope

The principles and recommendations apply to:

- ALL medication orders or prescriptions that are handwritten or pre-printed

Prescriptions should not contain ANY abbreviations other than those that are in universal and common use, such as the term ‘prn’ meaning ‘when required’. All drug names, protocols and procedures should be in English and written in full.

It is recommended that hospitals develop policies for prescribing terminology together with strategies for implementation within their institutions. In developing strategies, hospitals may wish to refer to the Joint Commission on Accreditation of Healthcare Organisations (JCAHO) ‘Implementation tips’ for eliminating dangerous abbreviations (http://www.jointcommission.org/PatientSafety/DoNotUseList/).

Although this document provides recommendations it is not all-inclusive. There may also be specific circumstances where other terminology may be considered safe. However, before hospital Drug and Therapeutic Committees (DTCs) decide to include such terminology in local policies the principles outlined in Table 1 should be applied. DTCs should continue to monitor incidents associated with prescribing terminology.
Recommendations for on-screen display of medicine names

- Medicine names
  E.g. Display the full medicine name

E.g. Use National Tall Man Lettering
Recommendations for on-screen display of medicines information

- Medicine orders
- Medicine selection lists

<table>
<thead>
<tr>
<th>Do this: 6.1.3.2a</th>
<th>Don't do this: 6.1.3.2b</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>per</strong></td>
<td><strong>per</strong></td>
</tr>
<tr>
<td>pergolide</td>
<td>pergolide</td>
</tr>
<tr>
<td>perhexiline</td>
<td>perhexiline</td>
</tr>
<tr>
<td>pericyazine</td>
<td>Periactin</td>
</tr>
<tr>
<td>perindopril</td>
<td>perindopril</td>
</tr>
<tr>
<td></td>
<td>Perindo</td>
</tr>
<tr>
<td></td>
<td>Perindobell</td>
</tr>
<tr>
<td>Perindo Combi</td>
<td>Perindo Combi</td>
</tr>
<tr>
<td>Perindobell</td>
<td>Perindobell</td>
</tr>
<tr>
<td>Periactin</td>
<td>Perindo Combi</td>
</tr>
<tr>
<td>cypéroptadine</td>
<td>perindopril + amLODIPIne</td>
</tr>
<tr>
<td>hydrochloride</td>
<td>perindopril + indapamide</td>
</tr>
<tr>
<td>Perindo - perindopril erbumine</td>
<td>Perindo Combi - perindopril erbumine + indapamide</td>
</tr>
<tr>
<td>Perindobell - perindopril erbumine</td>
<td>Perindobell - perindopril + amLODIPIne</td>
</tr>
</tbody>
</table>
Recommendations for on-screen display of medicines information

- Text, abbreviations and symbols
  E.g. Do not use abbreviations

### Dose based

**Do this:** 6.2.1c

*hydrocortisone 1% – cream – topical – to the affected area – **DOSE sparingly** – once a day at night*

**Don’t do this:** 6.2.1d

*hydrocortisone 1% – cream – topical – to the affected area – **DOSE sparingly** – **ON**

**Do this:** 6.3.2c

*digoxin – oral – **DOSE 250 MICROg** – once a day in the morning*

**Don’t do this:** 6.3.2d

*digoxin – oral – **DOSE 250 µg** – once a day in the morning*
Recommendations for on-screen display of medicines and numbers

- Numbers and units of measure
  E.g. Do not use trailing zeros

<table>
<thead>
<tr>
<th>Dose based</th>
<th><strong>Do this:</strong></th>
<th>6.3.5a</th>
<th><strong>Don’t do this:</strong></th>
<th>6.3.5b</th>
</tr>
</thead>
<tbody>
<tr>
<td>prednisolone – oral – <strong>dose</strong> 5 mg – once a day in the morning – after food</td>
<td>✔️</td>
<td></td>
<td>prednisolone – oral – <strong>dose</strong> 5.0 mg – once a day in the morning – after food</td>
<td>✗</td>
</tr>
</tbody>
</table>

E.g. Use a space between numbers and units of measure

<table>
<thead>
<tr>
<th>Dose based</th>
<th><strong>Do this:</strong></th>
<th>6.3.4c</th>
<th><strong>Don’t do this:</strong></th>
<th>6.3.4d</th>
</tr>
</thead>
<tbody>
<tr>
<td>insulin glargine 100 units/mL – <strong>Lantus</strong> – injection – subcutaneous – <strong>dose</strong> 32 units – once a day</td>
<td>✔️</td>
<td></td>
<td>insulin glargine 100 units/mL – <strong>Lantus</strong> – injection – subcutaneous – <strong>dose</strong> 32units – once a day</td>
<td>✗</td>
</tr>
</tbody>
</table>
**Recommendations for on-screen display of medicines information**

- **General information display**
  
  E.g. Never truncate part of a prescription

### Dose based

**Do this:**

- **goserelin** – implant – subcutaneous
  
  **Dose** 10.8 mg – once only

- **latanoprost** 50 MICROg/mL – eye drops – both eyes – **Dose** 1 drop – once a day

- **frusemide** – oral – **Dose** 40 mg – twice a day

- **sodium chloride** 0.9% – irrigation – intravesical – bladder – **Rate** 1 L/hour – continuous

- **ERYthromycin** – enteric capsule – oral
  
  **Dose** 500 mg – four times a day

- **enalapril** – oral – **Dose** 10 mg – once a day in the morning

- **digoxin** – oral – **Dose** 250 MICROg – once a day in the morning

**Don’t do this:**

- **goserelin** – implant – subcutaneous – **Dose**

- **latanoprost** 50 MICROg/mL – eye drops –

- **frusemide** – oral – **Dose** 40 mg – twice a day

- **sodium chloride** 0.9% – irrigation – intrave

- **ERYthromycin** – enteric capsule – oral –

- **enalapril** – oral – **Dose** 10 mg – once a day i

- **digoxin** – oral – **Dose** 250 MICROg – once a
Guidelines on order and format

**perindopril arginine** 10 mg + **amlodipine** 10 mg – tablet – oral – **DOSE 1 tablet** – once a day – at 08:00 am

**SUPPLY 30**

**paracetamol** 120 mg/5 mL + **codeine phosphate** 5 mg/5 mL + **promethazine hydrochloride** 6.5 mg/5 mL – **Painstop for Children Night-Time Pain Reliever** – oral liquid – oral – **DOSE 10 mL** – every 6 to 8 hours – when required for pain relief – do not exceed 4 doses in 24 hours – **SUPPLY 100 mL**
Consultation

• Initial draft review
• Roundtable to advise Commission
• Feedback from key stakeholders
• Open web national consultation
• Feedback from 30 sources, including collated responses
• Human factors evaluation
Human factors and electronic medication management

**Human factors** – the relationship between humans and the systems with which they interact (taking into account users’ physical, cognitive and perceptual limitations and affordances)

Partial task analysis to understand context of on-screen medicines display
- Literature review
- Interview system users
- Current practice in commercially available clinical software
GUIDELINES FOR THE ON-SCREEN DISPLAY OF MEDICINES – FINAL REPORT

A partial task analysis and heuristic evaluation were carried out to provide advice on twelve questions regarding human factors guidelines for the Australian Commission on Safety and Quality in Health Care.

Marcus O. Watson¹,²,³, Andrew Hill¹,², Lillian Cornish¹, Blake M. McKimmie¹, and Mark S. Horswill¹

¹School of Psychology, The University of Queensland
²Clinical Skills Development Service, Queensland Health
³School of Medicine, The University of Queensland
Human factors approach

• 12 questions cover key issues requiring human factors evaluation
• Heuristic evaluations conducted on the alternative solutions to each question
• The preferred option was clear in each case and included in the guidelines for on-screen display
• Outcomes from the human factors panel provide the rationales behind the final recommendations
• Alternative solutions are presented with rationale for rejection
Heuristic evaluation research methods

• Create display solutions based on example prescriptions
• Two alternative display formats based on prescription software available in Australia – column and dash formats
• Simulated screenshots providing plausible background
• Team of 5 heuristic evaluators provided written recommendations
• All experienced in medical human factors research
Key issues

Question 1: How should micrograms be displayed?
Question 2: How should “greater than” be displayed?
Question 3: How should “less than” be displayed?
Question 4: Is it appropriate to use the “/” symbol in an expression of product strength?
Question 5: Is it appropriate to use the “/” symbol in an expression of rate?
Question 6: Is it appropriate to reserve the “+” symbol for separating the active ingredients in a product?
Question 7: Is it appropriate to reserve the “&” symbol to separate multiple components in a multiple component pack?
Question 8: What term should be used for the separator label denoting quantity?

Question 9: What formatting guidelines should be recommended for the display of product names?

Question 10: What formatting guidelines should be recommended for the display of prescription elements other than product name?

Question 11: What human factors recommendations should be provided regarding the order in which the elements in a prescription should be presented on a computer display?

Question 12: What should be the guidelines relating to when the product brand name can be used in place of the list of active ingredients?
Issue 1: How should micrograms be displayed?

- Options tested

MICROg

microgram
mcg
Display as milligrams not micrograms (e.g. 0.25mg not 250 mcg)
µg
MICROgrams
microg
micrograms

Dose based

Do this: 6.3.2c

digoxin – oral – **Dose 250 MICROg** – once a day in the morning

Don’t do this: 6.3.2d

digoxin – oral – **Dose 250 µg** – once a day in the morning
Issues 2 and 3: How should greater than or less than be displayed?

Greater than
Option 1: greater than ✓
Option 2: >
Option 3: more than

Less than
Option 1: less than ✓
Option 2: <
Issues 4 and 5: Use of ‘/’ symbol

Expressing product strength, e.g. 200 mg/100 mL

- Option 1: /
- Option 2: per

Expressing rate, e.g. 1 L/hour

- Option 1: /
- Option 2: per
Issue 6: Using ‘+’ to separate active ingredients in a product

- Option 1: +
- Option 2: and
- Option 3: &
- Option 4: plus
- Option 5: /

perindopril arginine 10 mg + amLODIPIne 10 mg – tablet – oral – **Dose 1 tablet** – once a day – at 08:00 am

**Supply** 30
Issue 7: Using ‘&’ to separate multiple components in a multiple component pack

- Option 1: &
- Option 2: &
- Option 3: {&}
- Option 4: (&)
- Option 5: and
- Option 6: +
- Option 7: plus
- Option 8: /
- Option 9: )&(  
- Option 10: }&{  
- Option 11: }and{  
- Option 12: | & |
Issue 8: Separator label denoting quantity

- Option 1: supply
- Option 2: supply qty
- Option 3: quantity
- Option 4: supply quantity
- Option 5: qty

Pack based

**Do this:**

<table>
<thead>
<tr>
<th>atorvastatin 10 mg – tablet – oral</th>
<th>6.3.1c</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOSE 10 mg – once a day at night – SUPPLY 30</td>
<td></td>
</tr>
</tbody>
</table>

**Don’t do this:**

<table>
<thead>
<tr>
<th>atorvastatin 10 mg – tablet – oral – 10 mg 30 – once a day at night</th>
<th>6.3.1d</th>
</tr>
</thead>
</table>
Issue 9: Formatting guidelines for product name display

• Option 1: **guaiphenesin** 100 mg + **pseudoephedrine hydrochloride** 30 mg – Benadryl for the Family Chesty Cough and Nasal Congestion

• Option 2: **guaiphenesin** 100 mg + **pseudoephedrine hydrochloride** 30 mg – BENADRYL FOR THE FAMILY CHESTY COUGH AND NASAL CONGESTION

• Option 3: **GUAIPHENESIN** 100 mg + **PSEUDOEPHEDRINE HYDROCHLORIDE** 30 mg – Benadryl for the Family Chesty Cough and Nasal Congestion

• Option 4: **guaiphenesin** 100 mg + **pseudoephedrine hydrochloride** 30 mg – BENADRYL FOR THE FAMILY CHESTY COUGH AND NASAL CONGESTION

• Option 5: **guaiphenesin** 100 mg + **pseudoephedrine hydrochloride** 30 mg – Benadryl for the Family Chesty Cough and Nasal Congestion

• Option 6: **guaiphenesin** 100 mg + **pseudoephedrine hydrochloride** 30 mg – Benadryl for the family chesty cough and nasal congestion
Formatting guidelines for prescription element display

• Option 1:
  Dose value is bold; supply value is regular, non-bold

• Option 2:
  Dose and supply values are bold

• Option 3:
  Dose value is bold and italics; supply value is regular, non-bold

• Option 4:
  Typical current practice: all non-drug name elements are regular, lowercase
Order of prescription elements

• Option 1:
  Drug name/strength, Form, Route, Dose, Frequency, Supply

• Option 2:
  Drug name/strength, Form, Dose, Route, Frequency, Supply

• Option 3:
  Drug name/strength, Dose, Frequency, Form, Route, Supply

• Option 4:
  Drug name/strength, Frequency, Form, Dose, Route, Supply
Using the product brand name in place of active ingredients

• Option 1:
  Use brand name as sole descriptor of product only if it has 3 or more active ingredients

• Option 2: ✔
  Use brand name as sole descriptor of product only if it has 4 or more active ingredients

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Do this:

Kenacomb – ear drops – right ear

dose:
- triamcinolone acetonide 0.1%
- neomycin sulfate 0.25%
- gramicidin 0.025%
- nystatin 90,000 units/mL
Standardising medicines information at the clinical user interface
National guidelines for on-screen display of medicines information

**Clinical guidelines aim to**

- Prevent clinical safety incidents and reduce harm from medication errors; and
- Enhance the safety of MHR and other clinical information systems

**Consumer addendum**

- Extends from the clinical guidelines to present medicines information for consumers to manage their medicines safely
- Minimal differences between clinical and consumer
Exceptions for consumer addendum

• Use ‘in’, ‘over’ or other descriptors instead of ‘/’; spell out ‘morning’, ‘evening’ and other descriptors instead of using the 24-hour clock
• Use everyday words and avoid technical terms for consumer presentation, e.g. under the tongue for sublingual
• Expand instructions to improve clarity for consumer presentation, e.g. use of verbs in instructions so ‘2 tablets’ becomes ‘Take 2 tablets’
• Order of information for route differs in consumer-facing information
Summary

• Standardised and consistent approach to medicines information promotes safe use of medicines
• Paper based abbreviations and symbols do not necessarily transfer to electronic systems
• Human factors have contributed to the first set of principles for medicines presentation in Australia
• The guidelines (published March 2016) are a platform for health facilities in continued implementation of eMM
• Consumer addendum to the guidelines due late 2016.
With thanks to

- Marcus Watson\textsuperscript{1,2,3}, Andrew Hill\textsuperscript{1,2}, Lillian Cornish\textsuperscript{1}, Blake McKimmie\textsuperscript{1}, and Mark Horswill\textsuperscript{1}
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\textsuperscript{2}Clinical Skills Development Service, Queensland Health

- Mike Bainbridge
Clinical Engagement Lead APAC – SNOMED International

- John Barned and Andrew Westcombe
Australian Digital Health Agency

- Neville Board
Australian Commission on Safety and Quality in Health Care