National Guidelines for On-Screen Display of Clinical Medicines Information

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Suggested citation

Acknowledgement

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1. Executive summary

The *National guidelines for on-screen display of clinical medicines* information were developed by the Australian Commission on Safety and Quality in Health Care (the Commission) with funding support from the Australian Government Department of Health. The guidelines are part of an ongoing commitment to quality use of medicines described in the National Medicines Policy (and associated guiding principles), which form the platform for safe medicines use in Australia [1] [2]. They are also consistent with the Commission's goal of improving the safety of Australian digital health records.

The aim of these guidelines is to describe consistent, unambiguous terms and processes for on-screen display of medicines information in clinical information systems.

These guidelines are intended for those developing, assessing, procuring and implementing IT systems for medication management and electronic prescribing to:

- understand how design contributes to patient safety
- apply the recommendations during software development and iteration
- evaluate systems during procurement.

Unclear, incomplete or ambiguous displays increase the possibility of errors, which may result in harm to patients.

These guidelines will require ongoing evaluation and iterative review as experience grows in the use of electronic medication management. The guidelines represent an agreed format and structure for the safer clinical presentation of medicines on-screen.

This document is the first of two. The second document will provide guidelines for consumer-facing presentation of medicines information.

A wide range of stakeholders have contributed to the review process, including pharmacists, doctors, nurses and experts in the field of IT usability and user interface design.

These guidelines comprise recommendations for clear, unambiguous, standardised on-screen presentation of medicines information. A rationale accompanies each recommendation and is based on examples where error has occurred in both handwritten and electronic prescriptions.

More detailed clinical scenarios follow two patients through an inpatient hospital stay to community prescribing and dispensing and presentation in an electronic health record. These depict how the electronic medication management records may appear across the healthcare continuum using the Australian Medicines Terminology (AMT)[3].

1. Executive summary

Acronyms

Acronym	Term
ACSQHC	Australian Commission on Safety and Quality in Health Care
AMT	Australian Medicines Terminology
CUI	Common User Interface (Programme)
eMM	electronic medication management
FDA	Food and Drug Administration (US)
ISMP	Institute for Safe Medication Practices
IT	information technology
NEHTA	National E-Health Transition Authority
NPSA	National Patient Safety Agency
SNOMED CT®*	Systematized Nomenclature of Medicine, Clinical Terms
TGA	Therapeutic Goods Administration
WHO	World Health Organization

*"SNOMED CT" is a registered trademark of the International Health Terminology Standards Development Organisation (IHTSDO).

Medication errors remain the second most common type of healthcare incident reported in Australian hospitals and can result in serious adverse events [4] [5] [6] [7] [8] [9].

Similarly, medication errors in community settings can contribute to patient harm and hospital admissions [10] [11] [12]. Unclear, incomplete or confusing presentation of medicines information can increase the opportunity for health practitioners to make errors and cause patient harm [13] [14] [15]. Some of these errors can be serious (i.e. likely to lead to permanent reduction in body functioning, increased length of stay, a surgical intervention or death). Error-prone abbreviations occur in 8.4% of in-hospital medication orders [16] and at a considerably higher rate in outpatient prescribing [17]. A large proportion of error-prone abbreviations occur in handwritten prescriptions (61%); 27% involve medicine name abbreviations.

Providing clear, standardised medicines information in electronic medication management (eMM) has the potential to reduce errors, including procedural errors and error-prone abbreviations [18]. Patient safety and quality use of medicines may also be improved as a result. A recent review of 3,291 admissions across six wards in two Australian hospitals revealed a statistically significant reduction in error rates (4.28 errors per admission) following eMM implementation. This was largely driven by a fall in the 'procedural error' rate (i.e. unclear or incomplete or illegal orders) [13].

The prescriber orders medicines for a patient to achieve a benefit that outweighs the risk of giving that medicine. The '5 rights' [19] [20] (right patient, right medicine, right dose, right route and right time) are communicated clearly and unambiguously by healthcare providers to ensure the medicine is safely used according to the original intent.

The way that medicines information is displayed on-screen within clinical information systems is critical to the safe performance of the medicines management process (i.e. prescribe, dispense, administer) [21] [22]. Moreover, these systems have the potential to reduce medication errors by improving the way in which medicines information is communicated between healthcare professionals [23] [24].

Electronic medicines information may be accessed, processed and interpreted by a wide audience (e.g. consumers, prescribers, nurses, pharmacists, pharmacy technicians, other allied health professionals, and purchasing and supply staff). The healthcare professional, working across different workplaces and across multiple devices, encounters a variety of differently formatted medicines information in clinical systems. Consumers and health professionals may also access and view differently formatted medicines information across a number of health records, such as Medicare and the My Health Record system, including the prescription and dispense view, shared health summary and discharge summaries. Consistent communication is critical with an internationally diverse population where health professionals are increasingly mobile.

Prescribing, dispensing and administering using electronic information does not in itself ensure that errors will not occur. Unclear, incomplete or ambiguous displays can increase the possibility of people making errors, potentially resulting in harm to patients. A recent systematic review identified 42 design aspects of prescribing systems that influence usability, workflow, and the accuracy and completeness of medication orders [25]. Much research has shown that poor clinical information system design can lead to user errors (e.g. wrong medication selection) with up to 42% of prescribing errors attributed to poor system usability [26] [27] [28].

2. Introduction

Searching for a medication by text input typically retrieves a list of similarly-spelled medications, which can lead to incorrect selections via false recognition [29]. Incorrect medicine selection constitutes approximately 2% to 10% of all prescribing errors [13] [27] [30] [31] [32]. Receiving the wrong drug is responsible for approximately 16% of deaths caused by medication error [33]. There is also the potential for a user to select the wrong drug strength or formulation at this stage. Such errors constitute between 2% and 9.5% of prescribing mistakes [13] [27] [31] [34].

Prescribing an inappropriate dose accounts for up to 26% of prescribing errors [13] [32] [34] [35]. Approximately 40% of deaths caused by medication error are due to inappropriate dosage [33]. Errors of route and frequency also occur [27] [30]. Many prescription software packages use abbreviations to denote these instructions (e.g. 'q.i.d.' for 'four times per day' or 'p.o.' for 'orally') [36]. This practice is likely to be problematic, as abbreviations are more likely to be misread, impacted by a single typographic error, or misinterpreted compared with their unabbreviated equivalent [16].

Calculation errors were noted as common in several studies [37]. For example, one study found 8.6% of total administration errors were due to miscalculation. In addition to mathematical error, other common causes of dosage error include missing a decimal point due to a trailing zero or omission of a leading zero (creating a tenfold overdose), or confusing units of measurement [38]. Wrong route errors (e.g. administering intravenously rather than orally) are less common, but still occur [38]. In a review, nearly half of the included studies reported dosage errors among the top three administration errors [37].

An evaluation of two eMM systems in Australia found that system-related errors resulting from eMM use accounted for 35% of errors after electronic prescribing intervention [27]. Problematic or confusing presentation of data on-screen has been identified as a factor contributing to the generation of new kinds of errors following technology implementation [39]. These errors could be minimised through system redesign and targeted training [13] [27], accepting that poorly designed displays are not the only source of error. The key tenet for improved safety is that human factors are considered in the early design of such systems [40].

The design of clinical information systems is a rapidly evolving discipline, and these guidelines will require ongoing evaluation and iterative review as experience grows in the use of eMM [41] [42] [43]. Some recommendations will have only weak published 'healthcare-based' evidence to support their use. Their inclusion is based on 'human factors' evidence, consensus and consultation. Consistency of presentation to support a given recommendation is of utmost importance. This approach will allow evaluation where evidence to support use is lacking. Moreover, these efforts to develop consistent display standards will be enhanced by the consistent use of medicines terminology in these systems.

Healthcare providers are encouraged to seek and procure software systems that work towards implementation of the standard formatting and terms set out in these guidelines. This is expected to be an evolving process, acknowledging existing system capability and current limited clinical evidence associated with medicines information presentation.

The Commission is responsible for maintaining these guidelines and for reducing national barriers to implementation during their introduction and ongoing use.

Feedback on these guidelines will be collated for review by the Commission and considered by a Commission-convened expert advisory group. The outcomes of decisions on these issues will be made available on the Commission website.

3. Scope

These guidelines describe safety recommendations for on-screen display of medicines information in all eMMs where medicines information is used and recorded.

Within these guidelines, the term 'prescription' is used to define elements relating to a medicine that convey the intent of the prescriber of that medicine.

These guidelines apply to the display of medicines information in clinical information systems across the whole healthcare continuum, including:

- acute health services specifying, procuring and implementing electronic health systems that include medicines information
- general practice prescribing and other software vendors
- aged care electronic medication charts and ordering systems
- community health services
- mental health services
- pharmacy (inpatient, outpatient and community services)
- dental and allied health services.

These guidelines apply to the on-screen display of medicines information for a prescription, medicine chart and medicine selection list used to create the prescription. Other relevant applications are implied, including:

- hospital pharmacy dispensing
- community pharmacy dispensing
- the point of administration of medicines to an individual
- medication reconciliation
- the construction of discharge summaries, referrals and other health records.

These guidelines also provide principles for medicine presentation in selection lists. It is acknowledged that proprietary drug databases, state-level catalogues, hospital formularies and other legacy systems may not conform at the time of publication.

The majority of medicines information displays are 'pack-based' in primary, community and aged care. 'Dose-based' prescribing data is used in inpatient settings. Examples are provided for both pack-based and dose-based prescribing, where appropriate and significant (see Glossary).

A key piece of information associated with every prescription is that it has been made for the right indication, increasingly seen as a '6th right' of safe medicines use [44]. US centres of excellence in patient safety such as the Brigham and Women's Hospital are moving towards indication-based prescribing.

The user interfaces of electronic systems for medication are assembled from elements including text, graphics, user navigation elements, and screen layout formats. The guidelines focus on text display, acknowledging the requirements for other elements which shape the safe use of these systems. For example, visual cues and icons have been shown to enhance usability and safety [25].

These guidelines are intended to facilitate the design and ease of use of systems that display medicines information. In Australia, systems currently take a proprietary route to the display of medicines information. A user is required to re-familiarise themselves with the presentation of this safety-critical information for each clinical information system used. This is in contrast to other industries (e.g. finance, telecommunications and e-commerce) where years of high investment in IT and a strong commercial focus have resulted in a sophisticated awareness of the benefits of good usability. A clinical information system and its use at the point of care is more complex than most other environments. The case for unambiguous medicine display is well developed, and medicines information presented consistently and clearly may assist improvements in interoperability between clinical systems.

3. Scope

These guidelines will be further developed with time and evaluation. Moreover, the recommendations will form the basis of a second set of guidelines for the on-screen presentation of medicines information to consumers, including the consumer medication action plan and pharmacy dispensed medicines labelling [45].

These recommendations do not pronounce on the process of data entry and do not preclude the use of keystroke combinations or abbreviations and shortened forms to enable rapid data entry. These guidelines are restricted to screen presentation, and designers are encouraged to ensure easy and unambiguous data entry to achieve correct on-screen presentation.

All web-delivered applications should follow best practice in accessibility and inclusive design. Developers are encouraged to conform to the latest published and international standards, including ISO 9241 [46], covering ergonomics of human–computer interaction, and the Web Content Accessibility Guidelines (WCAG2.0) [47] endorsed by Australia for all government web sites [48].

The guidelines are intended to facilitate the steps involved in the prescribing process, but the processes themselves are out of scope, including the following:
- identifying the right patient in the system database
- review of patient's medicine information, including current and elapsed prescriptions
- medication reconciliation
- clinical decision support to confirm the suitability of the selected medicine
- electronic review of prescription, including a forcing function to prevent the printing of incomplete prescriptions
- medication alerts and advisories, including drug interactions, drug–disease interactions, allergy warnings and other contraindications
- processes involved in administering prescribed medications.

It is acknowledged that the growing use of smartphones and tablet computers for clinical purposes [49] necessitates the further development of the requirements for medicines presentation on smaller devices. However, these guidelines place the following items displaying medicines information out of scope:
- smart pumps, wearables, and other devices with small and/or low-resolution displays
- labeling of dispensed items, unit dose dispensing, and bags containing dispensed products
- mobile devices
- reference items and monographs.

Moreover, these guidelines do not confer recommendations on areas beyond medicines information (e.g. pathology requests and reporting), although a number of recommendations could be applied to other health informatics.

Application of these guidelines will assist health services verifying their services against the National Safety and Quality Health Service Standards [50]. They should also support education and introduction to undergraduate clinical programs to drive safety earlier in the process.

4. Aims and objectives

The aim of these guidelines is to describe consistent, unambiguous terms and processes for on-screen display of medicines information in clinical and consumer-facing information systems.

The objectives of these guidelines are to:

- standardise the format of on-screen display of medicines information
- enhance the safety of the medicines component of clinical-facing information systems
- reduce the burden on individuals and vendors by delivering consistent interface principles
- promote safe and quality use of medicines across Australian health care
- promote the migration of existing national medicines safety work into the electronic environment, including National Tall Man Lettering [51] and the Recommendations for Terminology, Abbreviations and Symbols used in the Prescribing and Administration of Medicines [52].

The development of nationally standardised guidelines for on-screen display of medicines information is consistent with the Commission's role to lead and coordinate national improvements in healthcare safety and quality.

5. Background

5.1 The Australian Commission on Safety and Quality in Health Care

The Commission was established in 2006 to lead and coordinate improvements to the safety and quality of Australian health care. Among the functions of the Commission specified in the *National Health Reform Act 2011* are requirements to:

- formulate standards, guidelines and indicators relating to healthcare safety and quality matters
- promote, support and encourage the implementation of these standards and related guidelines and indicators.

The Medication Safety Program promotes improvements in safety and quality of medicines use and operates in conjunction with the Safety in E-Health Program to assure the quality and safety dimension of eMM initiatives. Through this collaboration, the Commission makes available a range of resources to assist health service organisations and health professionals to safely implement and use eMM, primarily *Electronic medication management systems: a guide to safe implementation* (2012) [53]. The first edition of the guide was recommended for use across the health system by Australian Health Ministers in 2011 to optimise the efficiency and safety of eMM systems implementation in hospitals.

The Commission's Medication Safety Program focuses on the electronic future for medicines management, the objectives being to:

- develop and migrate medication standardisations into the electronic environment
- assure the safety dimension of national eMM initiatives
- evaluate and standardise medicines information in clinical information systems and electronic health record systems
- assist with the development, evaluation and refinement of the format of presentation of medicines in e-systems and the e-transfer of prescriptions.

A significant part of the Commission's Medication Safety Program has focused on standardising parts of the medication management pathway to improve safety, including:

- medication charts
- terminology, abbreviations and symbols used in recording, prescribing and administering medicines in hospitals
- medicines information presentation, such as National Tall Man Lettering and user-applied labelling of injectable medicines.

These standardisations provide a sound basis for future electronic health initiatives, including eMM. For more information on the Commission's medication safety initiatives, please visit the Australian Commission on Safety and Quality in Health Care at www.safetyandquality.gov.au/our-work/medication-safety.

5.2 Basis for presentation of medicines information

These guidelines are based on a broad variety of information sources, including:

- the Common User Interface (CUI) Clinical Applications and Patient Safety Programme (see Section 5.2.1) [54]
- publications such as *Design for patient safety: guidelines for safe on-screen display of medication information* (see Section 5.2.2)
- national standards and recommendations, such as the Recommendations for Terminology, Abbreviations and Symbols used in the Prescribing and Administration of Medicines (see Section 5.2.3) [55] [56] [57]
- good practice for prescription writing as detailed in the *Australian Medicines Handbook* [58].

These guidelines consolidate the principles of the above information sources and use them as a basis for application to Australian eMM. Moreover, it is acknowledged that the current standards for paper-based systems are not automatically applicable in the electronic environment.

Examples of medicines information presentation in these guidelines use the Australian Medicines Terminology (AMT) [59] as the standard nomenclature for all medicine names and dose forms. Routes of administration, dose and other components of a prescription are derived from SNOMED CT-AU [3] [60]. AMT uses concepts to define products, and further implementation AMT support is available from the National E-Health Transition Authority (NEHTA) (see Appendix 10.3.3) [61] [62].

5.2.1 The Common User Interface Programme

The CUI Programme [54] represents a large body of work undertaken by the National Health Service (NHS) in the UK in conjunction with Microsoft. The outcome was a portfolio of standards and guidance relating to the safe design of user interfaces for electronic healthcare systems.

The program's core objectives included:

- increasing patient safety
- increasing clinical take-up of electronic health systems
- reducing health professional training costs.

The CUI Programme guidance documents provide criteria for designing web-based or stand-alone applications for healthcare professionals. However, it is acknowledged that evaluation of CUI guidance implementation has not been reported.

The intellectual property in the CUI Programme documents is owned jointly by the NHS and Microsoft. The NHS chooses to make the documents freely available in perpetuity.

5.2.2 Design for patient safety: guidelines for safe on-screen display of medication information

Design for patient safety: guidelines for safe on-screen display of medication information [63] was developed by the NHS for in-hospital services from a variety of sources including:

- design guidance published by the CUI Clinical Applications and National Patient Safety Agency (NPSA) Patient Safety Programme [64]
- a review of existing research and guidance in the field of medication information design
- good practice prescription writing as detailed in the British National Formulary [65].

This is a UK publication where it is common practice to use the term 'generic' to describe the active ingredient within a branded product. Also, in contrast to the UK, Australia has a larger number of 'branded generic products' where the manufacturer or house branding is incorporated into the brand name and these are prescribed out of choice.

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

The Australian recommendations [66] were developed from extensive research, interrogation of incident reporting databases and the work of overseas groups, including the NPSA and the Institute for Safe Medication Practices (ISMP).

The recommendations include:

- principles for consistent prescribing terminology
- a set of recommended terms and acceptable abbreviations
- a list of error-prone abbreviations, symbols and dose designations that have a history of causing error and must be avoided.

This document was developed by a working group of the NSW Therapeutic Advisory Group's Safer Medicines Group [66].

5. Background

5.2.4 Human factors research

Human factors specialists apply evidence-based methods and knowledge about people in order to design, evaluate and improve the interaction between people, systems and organisations. Human factors engineering seeks to improve human performance by designing systems compatible with our physical, cognitive and perceptual abilities [67] [68] [69] [70].

Well-designed systems should minimise the risk of errors. In the current context, this would include medicine-related errors made by prescribers, pharmacists and nurses. Users should be able to enter prescription information, effectively navigate the system, and interpret medicines information according to the prescriber's original intent. These objectives might be typically attained by employing design strategies intended to, for example, reduce cognitive load and minimise the need to use working memory.

Although these guidelines outline current best practice for display of medicines information, it is expected that developers will also employ the latest published and international standards on human factors and usability, including the Web Content Accessibility Guidelines (WCAG2.0) [47].

There is clear evidence pointing to a number of factors that promote clear communication on-screen [71], especially:

- typeface
- font size and weight
- line length and predictability regarding truncation and wrapping (see Appendix 10.5)
- left and right justification
- highlighting techniques (colour, bold, shading, underline, italics, upper case)
- consistency in placement and location
- screen position (central or peripheral)
- information density.

Human factors design elements supported by heuristic analysis are recommended to enhance clarity and reduce ambiguity of displayed medicines information. Failure to deliver clear communication is associated with reduced performance, increased search times and increased number of errors. Care should be taken to use clear, concise wording and standardised formats [72] [73] [74] [75].

Human factors assessment was conducted to inform decisions on medicines information presentation where evidence for best practice from existing paper or electronic systems was inconclusive [76] (see Appendix 10.4).

Designers should also take into consideration international standards for human–computer interaction, including ISO 9241, a standard from the International Organization for Standardization (ISO) covering ergonomics of human–computer interaction [46].

5.2.5 National Tall Man Lettering List

The National Tall Man Lettering List [77] should be used for medicines with look-alike, sound-alike medicine names [78] [79]. This list has been compiled to include look-alike, sound-alike names that are known to cause confusion and have been predicted to pose the greatest risks to patient safety. The overall risk rating is a combination of measures that estimate:

- the likelihood that the medicine names and associated products will be confused
- the overall patient harm that may occur if this confusion occurred.

Details of the methodology and development of the National Tall Man Lettering List are available at the Commission web site in the National Standard for the Application of Tall Man Lettering Project Report [51]. Further guidance on AMT implementation and the use of National Tall Man Lettering is available at NEHTA's AMT web page [62].

Medicine names – see 6.1 for details

Item	Description	Source
6.1.1 Recommendation	Display full medicine names	ISMP, NPSA, AMT
Rationale	Avoid confusion arising from non-standard medicine names	
6.1.2 Recommendation	Display medicines available as different salts	ISMP, NPSA, AMT
Rationale	Avoid confusion caused by abbreviating or omitting salts	
6.1.3 Recommendation	Display active ingredient name and brand name using consistent font styles for each	NPSA
Rationale	Avoid confusion between active ingredient and brand name	
6.1.4 Recommendation	Use National Tall Man Lettering for medicine names known to cause confusion	WHO, NPSA, FDA, ISMP, ACSQHC
Rationale	Avoid confusion between 'look-alike, sound-alike' medicine names	

Text, abbreviations and symbols – see 6.2 for details

Item	Description	Source
6.2.1 Recommendation	Do not use abbreviations	NPSA, AMT
Rationale	Avoid confusion caused by abbreviations	
6.2.2 Recommendation	Display prescription details in full	ISMP
Rationale	Prevent misreading symbols as numbers or words	

6. Design recommendations

Numbers and units of measure – see 6.3 for details

Item	Description	Source
6.3.1 Recommendation	Use a consistent display format and order	CUI
Rationale	Prevent misinterpretation caused by different numerical elements having similar formats and units of measure	
6.3.2 Recommendation	Use standard approved units of measure, consistently formatted	NPSA, ACSQHC
Rationale	Prevent misreading or misinterpreting units of measure	
6.3.3 Recommendation	Use spacing and labels to differentiate display elements	ISMP
Rationale	Prevent misreading numbers due to close proximity of preceding words	
6.3.4 Recommendation	Use a space between numbers and units of measure	ISMP, AMT
Rationale	Prevent misreading numbers due to close proximity of trailing units of measure	
6.3.5 Recommendation	Do not use trailing zeros	ACSQHC
Rationale	Prevent misreading numbers	
6.3.6 Recommendation	Display numbers without ambiguity	AMT
Rationale	Prevent misreading numbers	
6.3.7 Recommendation	Use a comma to separate groups of three digits for numbers 1,000 and above	ISMP
Rationale	Prevent misreading very large numbers	
6.3.8 Recommendation	Use 'million' instead of 'mega'	ISMP
Rationale	Avoid confusion over the meaning of 'm' or 'mega'	

6. Design recommendations

General information display – see 6.4 for details

Item	Description	Source
6.4.1 Recommendation	Unambiguously position related elements and labels when using text wrapping	CUI
Rationale	Avoid confusion caused by visual dissociation between related prescription elements	
6.4.2 Recommendation	Never truncate any part of the prescription	CUI
Rationale	Prevent misinterpretation caused by part of the prescription not being visible	
6.4.3 Recommendation	Ensure the full details of multiple prescriptions in a selection list are accessible	CUI & Usability best practice
Rationale	Prevent misinterpretation caused by part of the prescription not being visible	

Examples to support the guidelines are used throughout this document, illustrating each recommendation in terms of appropriate and inappropriate display. They are schematic and contain fragments representing individual AMT components rather than representing the design of a prescribing system with full AMT descriptors.

In addition, highlighting techniques (e.g. colour, bold, shading, underline, italics, upper case) will enhance usability. The examples in the guidelines do not use all of these elements. Rather, designers are encouraged to employ these techniques to their best potential within their own systems.

6. Design recommendations

6.1 Medicine names

In general, medicine names may be confused with each other because of inevitable similarities due to the large number of names in use. Confusion can also arise when brand names are similar to the 'parent' active ingredient name, and by non-standard naming of medicines within electronic prescribing systems.

Errors resulting from these confusions are well documented in patient safety literature [27] [34] [62] [80]. The likelihood of these errors occurring can be reduced by following simple design recommendations when displaying medicine names in electronic systems.

6.1.1 Display full medicine names

Recommendation – use full medicine names
The medicine name should be displayed in the prescription, medication order, medicines list or selection list in full with no abbreviation.

See Section 6.1.3 for guidance on using active ingredient and brand names and Appendix 10.3.3 for naming medicines in accordance with the AMT.

Rationale – avoid confusion arising from non-standard medicine names
Confusion can be caused by adopting locally approved medicine names, abbreviations, truncation, and acronyms for medicines with similar names.

Local names may not be universally recognised and may be misinterpreted by an increasingly mobile workforce. In the worst case, a shortening or abbreviation in one locale may directly conflict with a similar shortening from a different locale.

This recommendation does not preclude the use of shortened forms for rapid data entry, provided the data entry results in the full medicine name appearing on-screen.

Moreover, the recommendation does not preclude the user searching for medicines by brand name during the order entry or selection process.

In the example shown, 'Cpl' may be read as 'chloramphenicol' or 'cyclopentolate', both of which are available as eye drops with a 0.5% concentration of active ingredient. These medicines are not interchangeable and would be unacceptable for short-cut data entry.[1]

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1   Individual AMT components are used to illustrate the recommendation and rationale. The actual AMT descriptors are chloramphenicol 0.5% eye drops [Medicinal Product Unit of Use (MPUU)] and chloramphenicol 0.5% eye drops, 10 mL [Medicinal Product Pack (MPP)].

Dose based

Do this: 6.1.1a   *Don't do this:*   6.1.1b

chloramphenicol 0.5% – eye drops – right eye – DOSE **1 drop** – four times a day ✔

cpl 0.5% – eye drops – right eye DOSE **1 drop** – four times a day ✖

Pack based

Do this: 6.1.1c   *Don't do this:*   6.1.1d

chloramphenicol 0.5% – eye drops – right eye – DOSE **1 drop** – four times a day SUPPLY 10 mL ✔

cpl 0.5% – eye drops – right eye DOSE **1 drop** – four times a day – SUPPLY 10 mL ✖

Dose based

Do this: 6.1.1e   *Don't do this:*   6.1.1f

isosorbide mononitrate – modified release tablet – oral – DOSE **60 mg** – once a day – swallow whole ✔

ISMN – modified release tablet – oral DOSE **60 mg** – once a day – swallow whole ✖

Pack based

Do this: 6.1.1g   *Don't do this:*   6.1.1h

isosorbide mononitrate 60 mg – modified release tablet – oral – DOSE **60 mg** – once a day – swallow whole – SUPPLY 30 ✔

ISMN 60 mg – modified release tablet – oral DOSE **60 mg** – once a day – swallow whole SUPPLY 30 ✖

Dose based

Do this: 6.1.1i   *Don't do this:*   6.1.1j

glyceryl trinitrate – sublingual DOSE **600 MICROg** – when required for chest pain ✔

GTN – sublingual – DOSE **600 MICROg** – when required for chest pain ✖

6. Design recommendations

6.1.2 Display medicines available as different salts

Recommendation – display the base name without the salt except where the full salt name defines the strength of the medicine

For medicines containing salts of a base active ingredient, use the base name without the salt (e.g. amoxycillin, not amoxycillin sodium).

However, include the salt as part of the active ingredient name for medicines available as different salts:

- where the salt results in a discernible therapeutic difference to the base (e.g. atropine sulfate), or
- where the salt defines the strength of the product (e.g. warfarin sodium 5 mg; phenytoin and phenytoin sodium).

For medicines where the salt confers a clinically significant potency:

- use the full name of the active ingredient (base and salt) (e.g. amphotericin B liposomal, lithium carbonate)
- display the salt details following the base name
- display the salt in full.

Refer to Appendix C of the *AMT editorial rules* [81] for further information on display of clinically significant salts. As a general rule, the expression of the name should be consistent with the display of the active ingredient within an AMT Medicinal Product Unit of Use.

Rationale – avoid confusion caused by abbreviating or omitting salts

Medicines containing salts displayed using the abbreviated forms of their chemical elements may be confusing.

Other abbreviated forms, either used alone or in combination with full words, can also be misleading, such as HCl, Br, K.

Dose based

Do this: 6.1.2a

diclofenac **sodium** – oral – DOSE **50 mg** – twice a day – after food ✓

Don't do this: 6.1.2b

diclofenac na – oral – DOSE **50 mg** – twice a day – after food ✗

Dose based

Do this: 6.1.2c

metoprolol tartrate – oral – DOSE **100 mg** – twice a day ✓

Don't do this: 6.1.2d

metoprolol – oral – DOSE **100 mg** – twice a day ✗

Pack based

Do this: 6.1.2e

quinine sulfate 300 mg tablet – oral DOSE **300 mg** – once a day at night SUPPLY 50 ✓

Don't do this: 6.1.2f

quinine – oral – DOSE **300 mg** – once a day at night – SUPPLY 50 ✗

In Example 6.1.2e, 'quinine sulfate 300 mg tablet' is the pre-coordinated AMT term and individual components are not listed separately. Hence, the AMT term is illustrated in bold typeface.

6. Design recommendations

6.1.3 Display active ingredient name and brand name using consistent font styles for each

Recommendation – display the active ingredient name

The active ingredient must be displayed except for combination products with four or more active ingredients or components.

To provide additional clarity, display **both** active ingredient and brand names for:

- medicines that have significant bioavailability issues, such as **warfarin sodium** (*Coumadin*)
- medicines posing a higher risk than normal, including insulin, amphotericin and chemotherapeutic agents
- medicines with two or three active ingredients, such as *Trizivir* tablets, which should be expressed as **abacavir** 300 mg + **lamivudine** 150 mg + **zidovudine** 300 mg – *Trizivir*.

The display order of the active ingredients in a combination product is derived from the innovator product.

The active ingredient name may be displayed alone for medicines that have significant bioavailability issues if there is only one available brand or the brand bioavailability is equivalent.

The brand name may be displayed alone for combination products, or multi-ingredient or multi-component products with four or more active ingredients or components. In this case, the active ingredient names must be displayed using a 'hover over' option with each active ingredient on a separate line (see Example 6.1.3.1e).

In a medicine selection list, display the active ingredient products first in the list followed by brand (innovator and branded generic) products. This separates the active ingredient from similarly named branded products, reducing the risk of selection error (see Example 6.1.3.2a).

Recommendation – systems should adequately differentiate between active ingredient and brand names

The following guidance on medicine name font styles is a suggested approach:

- Active ingredient names – Use lower case and bold typeface (**atenolol**)
- Brand names – Use italics (not bold) and title case. For example:
  - *Tenormin*
  - *Benadryl for the Family Chesty Cough and Nasal Congestion.*

Precede the brand name with an en dash (see Glossary) to provide further distinction between active ingredient and brand names (e.g. **perindopril arginine** 5 mg – Coversyl; see Section 6.3.3).

The application of National Tall Man Lettering takes precedence over this guidance (see Section 6.1.4)

Rationale – avoid confusion between active ingredient and brand name

National regulatory authorities (e.g. the Therapeutic Goods Administration [TGA]) and international organisations (e.g. the World Health Organization) attempt to ensure that the names of different medicines (both active ingredient and brand name) are sufficiently distinct from each other. This is challenging, given the ever-increasing number of medicines available [67] [76].

The brand name should only be displayed alone when display of active ingredient and brand names could cause confusion (e.g. combination products).

6. Design recommendations

6.1.3.1 Medicines order

Dose based

Do this:

morphine sulfate – *MS Contin* – modified release tablet – oral – DOSE **30 mg** – twice a day ✓

Don't do this:

morphine sulfate – modified release tablet – oral – DOSE **30 mg** – twice a day ✗

Dose based

Do this:

Kenacomb – ear drops – right ear DOSE **2 drops** – three times a day ✓

Don't do this:

triamcinolone acetonide 0.1% + **neomycin sulfate** 0.25% + **gramicidin** 0.025% + **nystatin** 90,000 units/mL – ear drops – right ear – DOSE **2 drops** – three times a day ✗

Dose based

Do this:

Kenacomb – ear drops – right ear DOSE

triamcinolone acetonide 0.1%

neomycin sulfate 0.25%

gramicidin 0.025%

nystatin 90,000 units/mL ✓

Don't do this:

Kenacomb – ear drops – right ear DOSE

triamcinolone acetonide 0.1% + **neomycin sulfate** 0.25% + **gramicidin** 0.025% + **nystatin** 90,000 units/mL ✗

Pack based

Do this:

warfarin sodium 5 mg – *Marevan* – tablet – oral – DOSE **5 mg** – once a day at night SUPPLY 50 ✓

Don't do this:

warfarin sodium 5 mg – tablet – oral DOSE **5 mg** – once a day at night – SUPPLY 50 ✗

6.1.3.2 Medicine selection list

The 'Do this' examples in this section are indicative only and show an AMT Medicinal Product (MP) concept description or a Trade Product (TP) concept description and the associated active ingredient.

In Example 6.1.3.2b, all the active ingredient and brand names starting with 'per' are listed alphabetically. For a clinician searching for an unfamiliar or infrequently used medicine, this list is problematic as it contains a large number of similar-looking and similar-sounding names. A list like this increases the possibility of selection error, potentially leading to the wrong medicine being administered to the patient.

The 'good' example separates the products according to the rules above and displays the active ingredients first, followed by the brand names with distinct font styles.

Do this: *6.1.3.2a*

per 🔍
pergolide
perhexiline
pericyazine
perindopril
▶ **perindopril + amLODIPIne**
▶ **perindopril + indapamide**
Periactin – **cyproheptadine hydrochloride**
Perindo – **perindopril erbumine**
Perindobell – **perindopril erbumine**
Perindo Combi – **perindopril erbumine + indapamide**

✔

Don't do this: *6.1.3.2b*

per 🔍
pergolide
perhexiline
Periactin
pericyazine
Perindo
Perindobell
Perindo Combi
perindopril
▶ perindopril + amLODIPIne
▶ perindopril + indapamide

✖

This example is a selection list where products are represented without strength in the expectation that a further step in the selection process would display and allow choice of products with the relevant strength, as shown in Example 6.1.3.2c.

6. Design recommendations

6.1.4 Use National Tall Man Lettering for medicine names known to cause confusion

Recommendation – use the National Tall Man Lettering List [51] [77] for medicines with look-alike, sound-alike names

Implementation of National Tall Man Lettering should be used for active ingredient names and brand names in prescribing and dispensing displays and medicine selection lists. This rule takes precedence over the font recommendations in Section 6.1.3. Therefore, for medicine names where National Tall Man Lettering applies, the font shall be a combination of lower case and upper case with:

- bold font applied to the active ingredient
- italics applied to the brand name.[3]

Care should be taken with sans serif fonts, as 'L' and 'I' may be visually identical, depending on their respective cases.

Rationale – avoid confusion between 'look-alike, sound-alike' medicine names

Confusion can occur between medicines which look or sound alike. The World Health Organization recognises this concern and has published a list of look-alike, sound-alike medicines [82]. In Australia, the National Tall Man Lettering List is managed by the Commission [77].

Errors may occur when a patient is prescribed two or more look-alike, sound-alike medicines. Moreover, errors may arise at the point of selection where there is choice between look-alike, sound-alike medicines. It is important to design displays that reduce the likelihood of users selecting an incorrect medicine from an electronic medicine selection list.

6.1.4.1 Medicines order

Dose based

Do this:　　6.1.4.1a

amLODIPIne – *norVASC* – oral
DOSE **10 mg** – once a day

amITRIPTYLIne hydrochloride – *Endep* – oral – DOSE **10 mg** – three times a day

Don't do this:　　6.1.4.1b

amlodipine – *norVASC* – oral
DOSE **10 mg** – once a day

amitriptyline hydrochloride – *Endep* – oral
DOSE **10 mg** – three times a day

Pack based

Do this:　　6.1.4.1c

amIODAROne 100 mg – *araTAC* – tablet – oral – DOSE **100 mg** – once a day in the morning SUPPLY 30

amLODIPIne 10 mg – *norVASC* – tablet – oral
DOSE **10 mg** – once a day – SUPPLY 30

Don't do this:　　6.1.4.1d

amiodarone 100 mg – *Aratac* – tablet – oral
DOSE **100 mg** – once a day in the morning
SUPPLY 30

amlodipine 10 mg – *Norvasc* – tablet – oral
DOSE **10 mg –** once a day – SUPPLY 30

6.1.4.2 Medicine selection list

For simplicity, this example does not show any potential brand name matches for a 'gli' search.

Do this: *6.1.4.2a*

> nor   🔍
>
> *Nordette 28* – **ethinyloestradiol + levonorgestrel**
> *norMISON* – **temazepam**
> *norVASC* - **amLODIPIne**

✅

Don't do this: *6.1.4.2.b*

> nor   🔍
>
> *Nordette 28* – **ethinyloestradiol + levonorgestrel**
> *Normison* – **temazepam**
> *Norvasc* - **amlodipine**

❌

Do this: *6.1.4.2c*

> gli   🔍
>
> **gliBENCLAMide**
> **gliCLAZide**
> **gliMEPIRide**
> **gliPIZide**

✅

Don't do this: *6.1.4.2d*

> gli   🔍
>
> **glibenclamide**
> **gliclazide**
> **glimepiride**
> **glipizide**

❌

---

3   The examples on this page show Tall Man lettering applied to an AMT amlodipine Medicinal Product concept description and to an AMT amitriptyline hydrochloride substance concept description. AMT does not include Tall Man lettering in descriptions at the time of publication.

6. Design recommendations

6.2 Text, abbreviations and symbols

Medicine has a strong tradition of using Latin words and abbreviations in place of full English words. This usage has continued due to a combination of handwritten communication on paper and increasing time pressures on practitioners. However, English is the predominant language used to describe medicines, and clinical staff raining does not include Latin or abbreviated terms to describe a medication order. While using Latin abbreviations may be convenient, their use is open to ambiguity and misunderstanding and ultimately may lead to patient harm [83].

Moreover, with an internationally mobile workforce, there is increasing potential for misunderstanding when using these conventions. This is also true for abbreviated forms of English words and the use of symbols in place of words.

Errors resulting from these misunderstandings are well documented in the patient safety literature [36] [84] [85] [86]. Electronic medication management systems can help prevent these errors by following simple design recommendations when displaying prescription details and medicine descriptions.

Human factors research [87] recommends the minimal use of abbreviations. Guidelines in Appendix 10.5 set out where wrapping may be appropriate. Abbreviations of dosing and units of measure should only be used with reference to Appendices 10.1 and 10.2.

Abbreviations and acronyms may be very helpful in accelerating the entry of clinical data, provided they are expanded into their full term before being finally stored and displayed.

6.2.1 Do not use abbreviations

Recommendation – display elements of a prescription in full, with no abbreviation, including:

- route of administration (e.g. oral)
- administration site (e.g. left ear)
- frequency description (e.g. at night)
- medicine form (e.g. ear/eye drops).

Exceptions to this recommendation:

- **Modified release products**, including slow release, controlled release and continuous release. The description used in the brand name may denote release characteristics, e.g. Tramal **SR**, Tegretol **CR**. Abbreviations to denote modifications of release that are part of the brand name should not be changed.
  However, note that AMT uses 'modified release' in full as part of the medicine dose form. This includes slow release and controlled release (e.g. tramadol hydrochloride 100 mg tablet: modified release, 10 tablets; or carbamazepine 200 mg tablet: modified release, 200 tablets).
- **Units of measure** may be abbreviated according to the recommended short forms in Appendix 10.1. In most cases, units falling within approved international standards are applied in these guidelines. However, units with potential for confusion and error may be described in a form which differs from approved international standards (see Appendix 10.1).
- **Days of the week** may be abbreviated to three letters, with the first letter capitalised (e.g. Mon, Tue, Sat). However, the full word is preferred where space is available.

Rationale – avoid confusion caused by abbreviations

The misinterpretation of abbreviations or acronyms increases where there are a number of interpretations of the shortened form.

In Example 6.2.1b, an error could occur if 'LE' was mistaken for 'left eye' rather than 'left ear'. The full description of 'left ear' avoids ambiguity.

In Example 6.2.1d, the Latin acronym 'ON' has been used instead of 'at night'. This may be misinterpreted, assumed to be an error, or overlooked and lead to incorrect medicine administration.

Dose based

Do this: 6.2.1a

framycetin sulfate 0.5% – eye/ear drops – left ear – DOSE **2 drops** – three times a day ✓

Don't do this: 6.2.1b

framycetin sulfate 0.5% – eye/ear drops – LE – DOSE **2 drops** – three times a day ✗

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 ✗

6.2.2 Display prescription details in full

Recommendation – use full English words in place of symbols

Use full English words to describe all text elements of a prescription. For example, the symbols '<' and '>' may be interpreted inversely to their meaning and must be displayed as 'less than' or 'greater than' in words. 'Greater than' is the preferred option across all contexts. However, terms specific to context (e.g. 'longer than' for duration and 'more than' for dose) may be used.

There are exceptions to this recommendation where replacing words would not confer a safety benefit:

- Use '%' instead of 'per cent'.
- Use decimal points instead of verbal descriptions of fractions (see exceptions in Section 6.3.6 for tablet quantities).
- Use the '+' separator to combine two or more active ingredients (preferred terms) within a single medicinal product (e.g. **paracetamol 500 mg + codeine phosphate 15 mg tablet** as an example of an AMT MP).
- Use the '&' separator to combine two or more components in a multi-component pack (e.g. the components of *Nexium Hp7*, **esomeprazole** 20 mg enteric coated tablets [14] & **clarithromycin** 500 mg tablets [14] & **amoxycillin** 500 mg capsules [28]).
- Use '/'
  o to separate measures within an expression of strength (e.g. 2 mg/mL)
  o to separate measures within an expression of rate (e.g. 10 mg/hour)
  o for brand name combinations (e.g. *Coversyl Plus* 5 mg/1.25 mg).

Rationale – prevent misreading symbols as numbers or words

Symbols may be misread as numbers. For example, the symbol '@' used in place of 'at' may be misread as the number 2.

The symbols '&' and '+' should be reserved for the specific purposes described above. They should not be used elsewhere, as supported by heuristic evaluation (see Appendix 10.4), because:

- the symbol '&' may be misread as the number 2 or the number 8
- the symbol '+' may be misread as the number 4 or a dash.

The compressed layout in Example 6.2.2b increases the likelihood of misinterpretation. In the example, the prescription could be misread as 'days 1 4 8', or the '+' could be misread as a dash, making the prescription appear to state 'days 1 – 8'. Misinterpretation in either case could lead to an overdose.

The administration schedule on days 1 and 8 is clearly described in Example 6.2.2a by nominating the dates of intended administration. In addition, time of administration is described in a standardised format.

Dose based

Do this: 6.2.2a

> **vinORELBine** – injection – intravenous –
> 11-Mar-2014 DOSE **50 mg** – at 10:00 am
> 18-Mar-2014 DOSE **50 mg** – at 10:00 am

Don't do this: 6.2.2b

> **vinORELBine** – injection – intravenous
> DOSE **50 mg** – days 1 + 8 @ 10

This example specifies a medicines order where relative dates are not acceptable.

Pack based

Do this: 6.2.2c

> **frusemide** 40 mg – tablet – oral – DOSE **40 mg**
> once a day at 10:00 am – SUPPLY 30

Don't do this: 6.2.2d

> **frusemide** 40 mg – tablet – oral – DOSE **40 mg**
> once a day @ 10 – SUPPLY 30

Refer to Appendix 10.2 for display of time according to the 24-hour clock.

6. Design recommendations

6.3 Numbers and units of measure

Prescription details and medicine product descriptions contain predictably structured combinations of words and numbers. Sometimes the juxtaposition of words and numbers can cause legibility problems. Also, some units of measure are known to be prone to misunderstanding and should not be used.

Errors resulting from these misunderstandings and legibility problems are well documented in patient safety literature [36] [84] [85] [86]. Electronic medication management systems can help avoid these errors by following some simple rules for formatting prescription details and medicine product descriptions, and by using only standard approved units of measure.

6.3.1 Use a consistent display format and order

Recommendation – Display elements of a prescription in a consistent format and order

- Use labels.

  Dose (or dose equivalent, such as volume or rate) is a key element and its prominence and readability is increased by:

  - o preceding it by a label
  - o using visually distinctive type (e.g. bold)
  - o using larger font to differentiate dose from strength (optional; e.g. appropriate for administration screens)

- Use separators.

  A separator increases the readability of separate data elements while reducing the amount of space needed between the elements. Recommended separators are:

  - o the en dash; however, do not use the en dash to precede a number to avoid erroneously implying a negative value
  - o the '+' separator to combine two or more active ingredients (preferred terms) within a single medicinal product (see Section 6.2.2)
  - o the '&' separator to combine two or more components in a multi-component pack (see Section 6.2.2).

A separator is not required between the active ingredient name and strength as these are inextricably linked. A separator is optional between frequency, frequency qualifier and indication. In most instances, the en dash will not improve readability, e.g. '2 tablets – four times a day when required for pain relief' is preferable to '2 tablets – four times a day – when required – for pain relief'.

- Use a consistent display order of prescription elements.

  The following examples are recommendations for the consistent display of single and multiple ingredient products in medicines orders. In relation to these examples, please note:

  - o for information on text wrapping in these orders see Section 6.4.1
  - o the mandatory elements required to create an order are defined. However, it is beyond the scope of this document to define where elements are mandatory or optional for other use cases including dispensing, supplying and administering medicines
  - o the examples show individual components that predefined AMT concepts will display in one description.

6. Design recommendations

Single active ingredient product: pack-based example

1. Active ingredient name	3. Brand name	6. Site	8. Dose	14. Duration of treatment for full course
2. Strength	4. Form	7. Label	10. Frequency	

chloramphenicol 0.5% – *Chlorsig* – eye drops – right eye – DOSE **1 drop** – four times a day – for 4 days SUPPLY 10 mL

16. Supply
15. Label
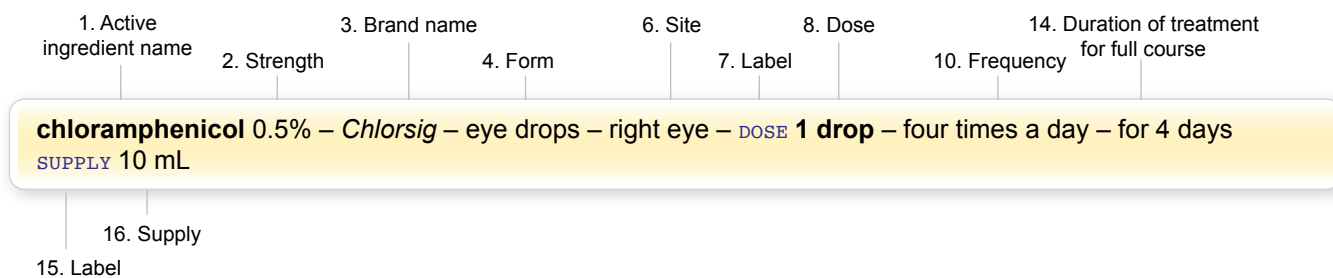
	Description	Example	Status	Notes
1	Active ingredient	**chloramphenicol**	Mandatory	
2	Strength	0.5%	Mandatory for pack-based prescribing	*Described as quantity, non-breaking space and a unit of measure* *Optional for dose-based prescribing*
3	Brand name	Chlorsig	Optional	*Mandatory for dispense according to display requirements in Section 6.1.3*
4	Form	eye drops	Optional	
5	Route	–	Mandatory	*Mandatory unless adequately described by Site*
6	Site	right eye	Optional	
7	Label	DOSE	Optional	*DOSE, RATE or VOLUME*
8	Dose	**1 drop**	Mandatory	*Or equivalent (e.g. rate or volume). This may be omitted where a dose cannot be expressed (e.g. creams and ointments).*
9	Administration duration	–	Optional	*This is the time over which a single dose is administered*
10	Frequency	four times a day	Mandatory	
11	Frequency qualifier	–	Optional	
12	Indication	–	Optional	*Mandatory for medicines prescribed 'when required'*
13	Additional instructions	–	Optional	
14	Duration of treatment for full course	for 4 days	Optional	
15	Label	SUPPLY	Mandatory	*Mandatory for pack-based prescribing*
16	Supply	10 mL	Mandatory	*Mandatory for pack-based prescribing*

LEGEND: Yellow indicates items to be presented in bold

Single active ingredient product: dose-based example

fluconazole 200 mg/100 mL – injection – intravenous – DOSE 200 mg – over 30 minutes – once a day – at 10:00 am – for 10 days
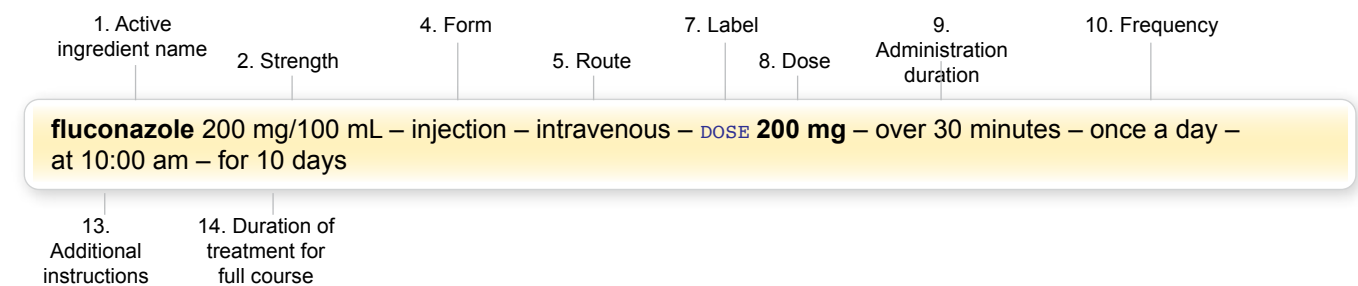
	Description	Example	Status	Notes
1	Active ingredient	**fluconazole**	Mandatory	
2	Strength	200 mg/100 mL	Mandatory for pack-based prescribing	*Described as quantity, non-breaking space and a unit of measure* *Optional for dose-based prescribing*
3	Brand name	–	Optional	*Mandatory for dispense according to display requirements in Section 6.1.3*
4	Form	injection	Optional	
5	Route	intravenous	Mandatory	*Madatory unless adequately described by site*
6	Site	–	Optional	
7	Label	DOSE	Optional	*DOSE, RATE or VOLUME*
8	Dose	**200 mg**	Mandatory	*Or equivalent (e.g. rate or volume) This may be omitted where a dose cannot be expressed (e.g. creams and ointments).*
9	Administration duration	over 30 minutes	Optional	*This is the time over which a single dose is administered*
10	Frequency	once a day	Mandatory	
11	Frequency qualifier	at 10:00 am	Optional	
12	Indication	–	Optional	*Mandatory for medicines prescribed 'when required'*
13	Additional instructions	–	Optional	
14	Duration of treatment for full course	for 10 days	Optional	
15	Label	–	N/A	*Mandatory for pack-based prescribing*
16	Supply	–	N/A	*Mandatory for pack-based prescribing*

LEGEND: Yellow indicates items to be presented in bold

6. Design recommendations

Two active ingredients product

1a. First active ingredient · 2a. Strength · 1b. Second active ingredient · 2b. Strength · 4. Form · 5. Route · 7. Label · 8. Dose · 10. Frequency · 13. Additional instructions

perindopril arginine 10 mg + **amLODIPIne** 10 mg – tablet – oral – DOSE **1 tablet** – once a day – at 08:00 am
SUPPLY 30

15. Label

16. Supply

	Description	Example	Status	Notes
1a	1st active ingredient	**perindopril arginine**	Mandatory	
2a	Strength of 1st active ingredient	10 mg	Mandatory for pack-based prescribing	*Described as quantity, non-breaking space and a unit of measure* *Optional for dose-based prescribing*
1b	2nd active ingredient	**amLODIPIne**	Mandatory	
2b	Strength of 2nd active ingredient	10 mg	Mandatory for pack-based prescribing	*As for first active ingredient*
3	Brand name	–	Optional	*Mandatory for dispense according to display requirements in Section 6.1.3*
4	Form	tablet	Optional	
5	Route	oral	Mandatory	*Mandatory unless adequately described by site*
6	Site	–	Optional	
7	Label	DOSE	Optional	*DOSE, RATE or VOLUME*
8	Dose	**1 tablet**	Mandatory	*Or equivalent (e.g. rate or volume). Omit where a dose cannot be expressed (e.g. topical preparations).*
9	Administration duration	–	Optional	*This is the time over which a single dose is administered*
10	Frequency	once a day	Mandatory	
11	Frequency qualifier	at 8:00 am	Optional	
12	Indication	–	Optional	*Mandatory for medicines prescribed 'when required'*
13	Additional instructions	–	Optional	
14	Duration of treatment for full course	–	Optional	
15	Label	SUPPLY	Mandatory	*Mandatory for pack-based prescribing*
16	Supply	30	Mandatory	*Mandatory for pack-based prescribing*

LEGEND: Yellow indicates items to be presented in bold

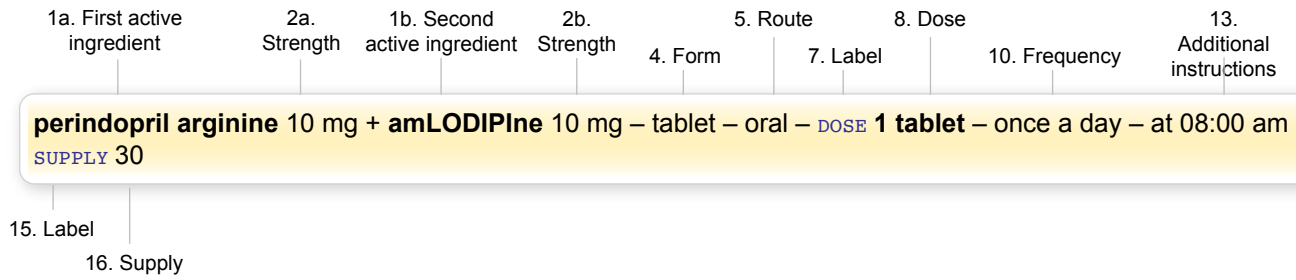# 6. Design recommendations

Three active ingredients product

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

Labels above the example:
- 1a. First active ingredient
- 2a. Strength
- 1b. Second active ingredient
- 2b. Strength
- 1c. Third active ingredient
- 2c. Strength

Labels below the example:
- 3. Brand name
- 13. Additional instructions
- 4. Form
- 5. Route
- 15. Label
- 7. Label
- 16. Supply
- 8. Dose
- 10. Frequency

	Description	Example	Status	Notes
1a	1st active ingredient	**paracetamol**	Mandatory	
2a	Strength of 1st active ingredient	120 mg/5 mL	Mandatory for pack-based prescribing	*Described as quantity, non-breaking space and unit of measure* *Optional for dose-based prescribing*
1b	2nd active ingredient	**codeine phosphate**	Mandatory	
2b	Strength of 2nd active ingredient	5 mg/5 mL	Mandatory for pack-based prescribing	*As for first active ingredient*
1c	3rd active ingredient	**proMETHazine hydrochloride**	Mandatory	
2c	Strength of 3rd active ingredient	6.5 mg/5 mL	Mandatory for pack-based prescribing	*As for first active ingredient*
3	Brand name	*Painstop for Children Night-Time Pain Reliever*	Optional	*Title case*
4	Form	oral liquid	Optional	
5	Route	oral	Mandatory	
6	Site	–	Optional	
7	Label	DOSE	Optional	*DOSE, RATE or VOLUME*
8	Dose	**10 mL**	Mandatory	*Or equivalent (e.g. rate or volume). This may be omitted where a dose cannot be expressed (e.g. creams and ointments).*
9	Administration duration	–	Optional	*Time over which a single dose is administered*
10	Frequency	every 6 to 8 hours	Mandatory	
11	Frequency qualifier	when required	Optional	
12	Indication	for pain relief	Optional	*Mandatory for medicines prescribed 'when required'*
13	Additional instructions	do not exceed 4 doses in 24 hours.	Optional	*The calculation of a maximum daily dose of paracetamol is outside of the scope of this document.*
14	Duration of treatment for full course	–	Optional	
15	Label	SUPPLY	Mandatory	*Mandatory for pack-based prescribing*
16	Supply	100 mL	Mandatory	*Mandatory for pack-based prescribing*

LEGEND: Yellow indicates items to be presented in bold
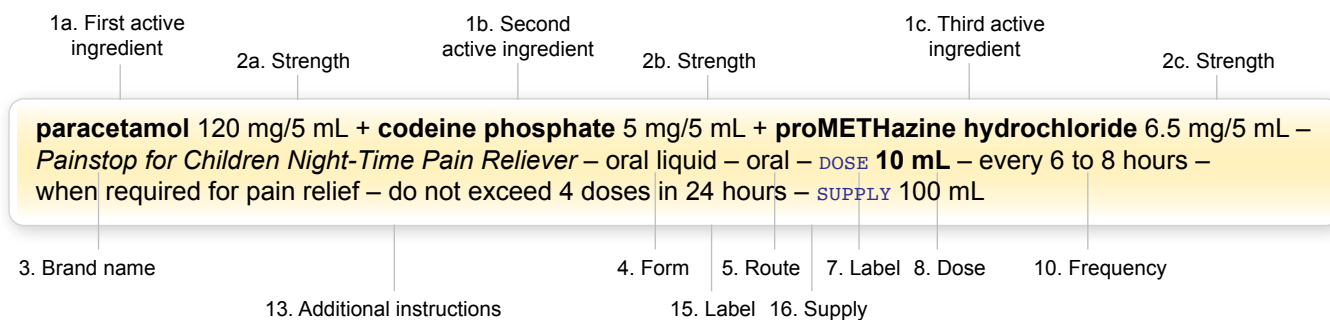
6. Design recommendations

Product with four or more active ingredients

For example, the fixed dose combination medicine Stribild, which contains:

- tenofovir disoproxil fumarate 300 mg
- emtricitabine 200 mg
- elvitegravir 150 mg
- cobicistat 150 mg.

Display the brand name alone for all fixed dose formulations with four or more ingredients (see Section 6.1.3). However, the active ingredients should be easily accessible (e.g. fully displayed on 'hover over', with each active ingredient displayed on a separate line).

3. Brand name   5. Route   8. Dose   12. Additional information
      4. Form   7. Label   10. Frequency

Stribild – tablet – oral – ᴅᴏꜱᴇ **1 tablet** – once a day – with food – ꜱᴜᴘᴘʟʏ **30**

15. Label
      16. Supply

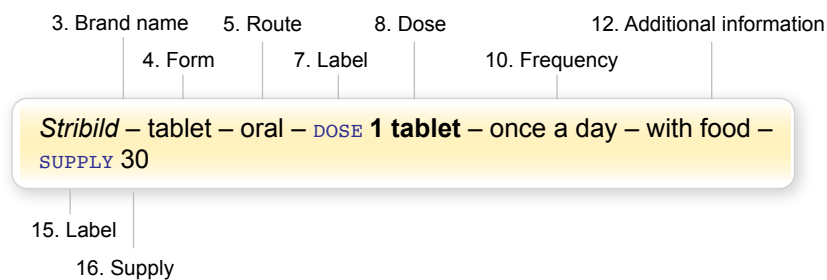|	Description	Example	Status	Notes
1	~~Active ingredient~~	–	~~Mandatory~~	
2	~~Strength~~	–	~~Optional~~	
3	Brand name	*Stribild*	Mandatory	*Title case*
4	Form	tablet	Optional	
5	Route	oral	Mandatory	
6	Site	–	Optional	
7	Label	DOSE	Optional	*DOSE, RATE or VOLUME*
8	Dose	**1 tablet**	Mandatory	*This may be omitted where a dose cannot be expressed (e.g. creams and ointments).*
9	Administration duration	–	Optional	*Time over which a single dose is administered*
10	Frequency	once a day	Mandatory	
11	Frequency qualifier	–	Optional	
12	Additional instructions	with food	Optional	
13	Indication	–	Optional	*For medicines prescribed 'when required'*
14	Duration of treatment for full course	–	Optional	
15	Label	SUPPLY	Mandatory	*Mandatory for pack-based prescribing*
16	Supply	30	Mandatory	*Mandatory for pack-based prescribing*

LEGEND: Yellow indicates items to be presented in bold

For oral liquid preparations, dose should be expressed in weight as well as volume. For example, in the case of morphine oral liquid (5 mg/mL), prescribe the dose in milligrams and confirm the volume in brackets; for example, 10 mg (2 mL). This is particularly important for products available in multiple strengths, where selection of an incorrect product may result in an incorrect dose being delivered.

See Appendix 10.2 for standardised terminology used to describe these prescription elements on-screen.

Rationale – prevent misinterpretation caused by different numerical elements having similar formats and units of measure

Confusion can be caused by different elements of the same prescription, especially those containing numbers, or having similar formats and units of measure.

The most common problem is mistaking the strength (i.e. concentration) of the medicine for the dose specified by the prescriber.

Clinical information systems can reduce the likelihood of this problem arising by:

- displaying elements in familiar or consistent sequence
- using appropriate units of measure and symbols
- differentiating similar elements of the prescription
- using labels as separators.

Other types of separators may take up less space than the en dash, such as commas. However, although commas produce a more compact output, human factors imply they may adversely impact readability [54].

Dose based

Do this: 6.3.1a

fluconazole 200 mg/100 mL – injection – intravenous – DOSE **200 mg (100 mL)** – over 30 minutes – once a day – for 10 days

Don't do this: 6.3.1b

fluconazole 200mg/100mL – injection – intravenous – 10 days – once a day – 30 minutes

Pack based

Do this: 6.3.1c

atorvastatin 10 mg – tablet – oral DOSE **10 mg** – once a day at night – SUPPLY 30

Don't do this: 6.3.1d

atorvastatin 10 mg – tablet – oral – **10 mg** 30 – once a day at night

6. Design recommendations

6.3.2 Use standard approved units of measure, consistently formatted

Recommendation – use standard approved units of measure with the upper and lower case formatting exactly as described in Appendix 10.1

Some commonly used examples include:

- 'units' for 'units' (i.e. do not abbreviate)
- 'mL' for 'millilitres' (capital 'L').

Consistently use either the full or abbreviated format, noting that these may not necessarily reflect approved international standards for units of measure (see Appendix 10.1). Do not be tempted to expand even if adequate display space is available (e.g. by replacing 'mg' with 'milligrams' in some situations). A lack of consistency in one situation may increase the probability of confusion elsewhere.

Rationale – prevent misreading or misinterpreting units of measure

Units of measure are vital components of a prescription. IT systems can help reduce the possibility of misinterpretation by displaying only standard approved units of measure, in full or abbreviated, and using these consistently at all times.

Units of measure associated with error include

- 'U' for 'unit' being misread as the number '0', causing a tenfold dose error
- 'l' for 'litre' being misread as the number '1'.

Errors are more likely when proper spacing is not used between numbers and units of measure (see Section 6.3.4).

Dose based

Do this: *6.3.2a*

insulin glargine 100 units/mL – *Lantus* – injection – subcutaneous – DOSE **32 units** – once a day ✓

Don't do this: *6.3.2b*

insulin glargine 100 units/mL – *Lantus* – injection – subcutaneous – DOSE **32 u** – once a day ✗

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 ✗

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6. Design recommendations

6.3.3 Use spacing and labels to differentiate display elements

Recommendation – use unambiguous spacing between the different display elements, so that there is no possibility of letters appearing to flow into the numbers which follow them

This can be achieved by using:

- a label or description, such as the word 'DOSE' (as in Example 6.3.3a)
- a single non-breaking space to separate the label from the following number.

If a non-breaking space is used, numbers and units will not be separated when wrapping occurs.

The en dash is a spacing tool which should be reserved for separating discrete elements (see Section 6.3.1).

Rationale – prevent misreading numbers due to close proximity of preceding words

Confusion is possible when the last letters of a word, typically the name of a medicine, appear to flow into the numbers which follow.

In Example 6.3.3b, a prescription for 'propranolol 60 mg' could be misread as 'propranolol 160 mg'.

This is a particular problem when the misread dosage is credible (as in this case, where propranolol 160 mg tablets are in regular use and available as *Deralin*).

An en dash will reduce potential confusion between different prescription elements, including active ingredient and brand names. However, the en dash should only precede words. Use of the en dash before a number may mislead by implying the negative (see Section 6.1.3).

Dose based

Do this: *6.3.3a*

propRANOLol – oral – DOSE **60 mg** – twice a day ✓

Don't do this: *6.3.3b*

propRANOLol60 mg – oral – twice a day ✗

6.3.4 Use a space between numbers and units of measure

Recommendation – leave a blank space between a number and unit of measure

Leave a single blank, non-breaking space between a number and its unit of measure (e.g. 32 units).

Rationale – prevent misreading numbers due to close proximity of trailing units of measure

Confusion is possible when numbers appear to flow into the units of measure which follow them. This situation can be exacerbated by insufficient spacing and incorrect display of units of measure.

In Examples 6.3.4b and 6.3.4d, no spacing has been used between the numbers and units of measure.

In the case of the sodium chloride infusion, the result may be misread as '11 litres per hour'. While the actual administration of 11 litres per hour would be very unlikely, the example shown would still be confusing. For the insulin injection, the dose may be misread as 320 units, with a tenfold increase of the intended dose.

Dose based

Do this: 6.3.4a

> **sodium chloride** 0.9% – irrigation –
> intravesical – bladder – RATE **1 L/hour**
> – continuous ✓

Don't do this: 6.3.4b

> **sodium chloride** 0.9% – irrigation –
> intravesical – bladder – RATE **1L/hour**
> – continuous ✗

Dose based

Do this: 6.3.4c

> **insulin glargine** 100 units/mL – *Lantus* –
> injection – subcutaneous – DOSE **32 units** –
> once a day ✓

Don't do this: 6.3.4d

> **insulin glargine** 100 units/mL – *Lantus* –
> injection – subcutaneous – DOSE **32units** –
> once a day ✗

6. Design recommendations

6.3.5 Do not use trailing zeros

Recommendation – do not use trailing zeros when displaying whole numbers

Clinical information systems must be flexible enough to change display formats according to the actual value of the numbers shown, so that whole numbers are shown as integers (i.e. to zero decimal points).

Rationale – prevent misreading numbers

If numbers have a trailing zero (a decimal point followed by a zero) there is potential to miss the decimal point and administer a tenfold overdose.

In Example 6.3.5b, the displayed dose of '5.0 mg' could be misread as '50 mg'.

This is a particular problem in situations where the misread dosage is within the typical range for the medicine. This makes it likely that, if the dose was misread, then the overdose would be administered to the patient.

Dose based

Do this: — 6.3.5a

prednisolone – oral – DOSE 5 mg – once a day in the morning – after food ✓

Don't do this: — 6.3.5b

prednisolone – oral – DOSE 5.0 mg – once a day in the morning – after food ✗

6.3.6 Display numbers without ambiguity

Recommendation – avoid fractions and decimals and use leading zeros when required

- Use units of measure that avoid fractions and decimals when displaying numerical information. For example:
  - use '500 mg' in place of '0.5 g'
  - use '500 MICROg' in place of '0.5 mg'

However, this is not advisable when the smaller unit of measure is not commonly used. For example, '600 microlitres' is not an acceptable alternative to '0.6 mL'.

- Use a leading zero where a decimal point is required for a value less than 1.
- Use 'half' and not '0.5' for description of tablet quantity.

Rationale – prevent misreading numbers

Fractions may be misinterpreted. For example, 1/7 could be interpreted as 'for one day', 'once daily', 'for one week' or 'once weekly', or '½' could be interpreted as 'half' or as 'one to two'.

Omitting leading zeros introduces a high possibility of misreading errors, because the decimal point preceding the number(s) may not be noticed.

Use AMT editorial rules [81] for units of measure. Convert units to avoid large numbers where possible. For example, use 1 g instead of 1000 mg. There are exceptions:

- Where a product has a range of strengths that span micrograms and milligrams – it is safer for that product range to have same unit of measure, so a microgram description over 1000 may be retained instead of converting to milligrams (e.g. fentanyl lozenges 1600 microgram).
- Where units should be presented with consideration for the target consumer – it is safer to use a microgram description in paediatric prescribing for a medicine expressed in milligrams for adult prescribing (e.g. for a child, prescribe adrenaline intravenous injection 50 MICROg rather than 0.05 mg).

Dose based

Do this: *6.3.6a*

cyclosporin 100 mg/1 mL – *Sandimmun* – oral liquid – oral – DOSE **60 mg (0.6 mL)** – twice a day ✅

Don't do this: *6.3.6b*

cyclosporin 100 mg/1 mL – *Sandimmun* – oral liquid – oral – DOSE **.6 mL** – twice a day ❌

Pack based

Do this: *6.3.6c*

paracetamol 500 mg – tablet – oral DOSE **2 tablets** – every 6 hours when required for pain relief – do not exceed 8 tablets in 24 hours – SUPPLY 50 ✅

Don't do this: *6.3.6d*

paracetamol 0.5 g – tablet – oral DOSE **2 tablets** – every 6 hours when required for pain relief – do not exceed 8 tablets in 24 hours – SUPPLY 50 ❌

Pack based

Do this: *6.3.6e*

terbinafine 250 mg – tablet – oral DOSE **HALF a tablet** – once a day – SUPPLY 42 ✅

Don't do this: *6.3.6f*

terbinafine 250 mg – tablet – oral DOSE **0.5 tablets** – once a day – SUPPLY 42 ❌

6.3.7 Use a comma to separate groups of three digits for numbers 1,000 and above

Recommendation – for numbers which have four or more whole-number digits, use a comma to separate groups of thousands

For example:

- 100
- 999
- 1,000
- 9,999
- 10,000
- 99,999
- 100,000

This recommendation aids visual interpretation of large numbers by breaking them up into groups of thousands and avoiding tenfold (or even 100-fold) misreading errors. Consideration should also be given to the use of 'million' where appropriate (see Section 6.3.8).

Note: The comma should be reserved for breaking up and interpreting large numbers and for the purposes of these guidelines a large number is any number over 1,000.

Rationale – prevent misreading very large numbers

A long continuous string of zeros is hard to interpret correctly.

This is a particular issue with medicines that are described by an estimate of activity where the unit of measure is 'unit' rather than by mass (e.g. 'g' or 'mg'). Unfortunately, medicines measured by activity are both frequently used and associated with high rates of error.

In Example 6.3.7b, the dose could be misread as '1000', rather than '10,000'. When read in conjunction with an inappropriately displayed unit of measure it could also be misread as '100,000'.

Dose based

Do this: 6.3.7a

heparin sodium – injection – subcutaneous
DOSE **10,000** units – every 12 hours ✓

Don't do this: 6.3.7b

heparin sodium – injection – subcutaneous
DOSE **10000** units – every 12 hours ✗

6. Design recommendations

6.3.8 Use 'million' instead of 'mega'

Recommendation – always display the word 'million' in full

Do not use 'mega' or 'm' or 'M' to abbreviate 'million'.

The word 'million' is preferred for whole increments of a million (e.g. 6 million).

Fractions of a million should be written numerically (e.g. 7,350,000, not 7.35 million).

Rationale – avoid confusion over the meaning of 'm' or 'mega'

The word 'mega', meaning one million, may cause confusion, as it can be mistaken for 'thousand' (because of the association with the prefix 'milli'), either when written in full or when abbreviated to 'm' or 'M'. 'Mega' can also cause problems when used in conjunction with 'units' (i.e. activity), as there is a high possibility of misreading the abbreviation 'mu' as 'mg'.

In Example 6.3.8b, either of these misinterpretations is possible. Neither is likely to lead to an actual error because of the strengths available and units of measure used on the product packaging. However, such misinterpretations are avoidable.

Dose based

Do this: *6.3.8a*

> **interferon alfa** – *Roferon A* – injection – subcutaneous – DOSE 9 **million units** – three times a week on Mon Wed Sat

Don't do this: *6.3.8b*

> **interferon alfa** – *Roferon A* – injection – subcutaneous – DOSE 9 **mega units** – three times a week on Mon Wed Sat

Fractions of a million written in full are less likely to be mistaken for larger denominations. For example, 7,350,000 is unlikely to be mistaken for 7,350,0000 or 7,350,00000. However, 7.35 million may be read as 735 million.

6. Design recommendations

6.4 General information display

Misinterpretation and legibility problems may arise when the prescription elements are assembled together on-screen. There is potential for problems to arise from the way that the component parts are placed in relation to each other and the way that they are organised in relation to the whole screen.

Serious problems may emerge when prescription details or medicine names are truncated, and truncation is unacceptable for on-screen display (see Appendix 10.5). The visible information may be read in isolation and inferences made about the non-visible information.

Errors resulting from these problems are well documented in patient safety literature and have been supported by user research [88]. Dose errors can be avoided in eMMs by following simple formatting rules, using software that successfully manages text wrapping, and avoiding truncation or partial display of prescription details.

6.4.1 Unambiguously position related elements and labels when using text wrapping

Recommendation – keep text wrapping to a minimum

The following recommendations may reduce the probability of error due to unintended visual associations when used in conjunction with other recommendations in these guidelines. Further methodology and results are summarised in Appendix 10.5.

Position related elements to ensure that the following combinations are placed on the same line:

- active ingredient and strength
- route and site
- dose label, dose and dose units (e.g. 'DOSE.', '240' and 'mg' in Example 6.4.1a)
- supply label and supply

In addition, position related elements to ensure that:

- hyphenation is not required
- the dose label, dose, administration duration and frequency are on the same line if possible
- the contents of a single element are kept together unless it will not fit on one line (e.g. DOSE 12 units in Example 6.4.1c). If a long medicine name exceeds the available screen space and has to be wrapped, ensure that the medicine name is wrapped between words and trailing delimiters are kept with the preceding element [89] (e.g. *Actrapid* in Example 6.4.1c).

The en dash at the end of a line is optional if the next item is a label.

6. Design recommendations

Rationale – avoid confusion caused by visual dissociation between related prescription elements

Confusion can be caused when information becomes too long to fit onto a single line. This 'text wrapping' can result in unclear juxtapositions of similar elements of the prescription, thereby increasing the possibility of confusion between them. However, it should also be noted that if all relevant information cannot be viewed at once (e.g. a line of information is too wide for the display and hence requires scrolling to view some elements), this may lead to safety-critical information being missed. That is, the use of text wrapping may have to reflect a compromise between competing safety issues.

Dose based

Do this: — 6.4.1a

paracetamol 120 mg/5 mL – oral liquid – oral – DOSE **240 mg (10 mL)** – every 6 hours when required for headache – do not exceed 4 doses in 24 hours ✓

Don't do this: — 6.4.1b

paracetamol 120 mg/5 mL – oral liquid – oral – DOSE **240 mg (10 mL)** – every 6 hours when required for headache – do not exceed 4 doses in 24 hours ✗

Dose based

Do this: — 6.4.1c

insulin neutral human 100 units/mL – *Actrapid* – injection – subcutaneous DOSE **12 units** – twice a day ✓

Don't do this: — 6.4.1d

insulin neutral human 100 units/mL – *Actrapid* – injection – subcutaneous DOSE **12 units** – twice a day ✗

6.4.2 Never truncate any part of the prescription

Recommendation – do not truncate information which is too large to be accommodated within the standard size of the element of the screen in which it belongs [90]

If necessary, wrap the prescription information (see Section 6.4.5), even if this means that fewer prescriptions overall are displayed. However, do not display a part of the prescription line alone if its meaning relies on other parts that are not displayed.

This can be achieved by using standard display technologies which allow screen elements to expand dynamically to display the full information provided. Other methodologies are discussed in Appendix 10.5.

Rationale – prevent misinterpretation caused by part of the prescription not being visible

Confusion can be caused by part of the prescription not being visible. For example, information within a particular section of the screen that is too large to be accommodated within a single line may be ambiguous if truncated.

Users may be tempted to assume that they know what information is hidden, when in fact the hidden information may not be as expected. In this case, it might be reasonable to assume that the hidden information is 'tenofovir disoproxil fumarate, emtricitabine, elvitegravir and cobicistat' (active ingredients in *Stribild*) when in fact it is 'tenofovir disoproxil fumarate, emtricitabine and efavirenz'. This is a specific instance of a more general problem, where an incorrect assumption would lead to the administration of the wrong medicine or dose.

Dose based

Do this: 6.4.2a

> **tenofovir disoproxil fumarate** 300 mg + **emtricitabine** 200 mg + **efavirenz** 600 mg – tablet – oral – DOSE **1 tablet** – once a day – on an empty stomach ✅

Don't do this: 6.4.2b

> **tenofovir disoproxil fumarate** 300 mg + **emt...** DOSE **1 tablet** – once a day – on an empty stomach ❌

6.4.3 Ensure the full details of multiple prescriptions in a selection list are accessible

Recommendation – where possible, use vertical scrolling and do not allow any part of the prescription to scroll horizontally off-screen

Text wrapping will be necessary even though this increases the need for vertical scrolling [89].
Refer to Section 6.4.1.

Use a look-ahead scroll notification and ensure that the notification does not overlay or truncate other information [91]. A standard scroll bar is supplemented with notifications at the top and bottom to indicate that there are items in the list that are not currently visible. This notification alters the standard scroll-bar control and reminds the user that more information is viewable 'below the fold' (i.e. scrolled off-screen).

These elements can be adjusted on clinician-specific user screens. In particular, the dose field on the administration view may be made much larger to distinguish it from the strength.

These recommendations will improve safety by ensuring that all required information is immediately visible, and reminding users to scroll down long lists. This may mean that fewer prescriptions are displayed overall.

Where vertical scrolling is implemented, care should be taken to ensure that all details for a given medication order or prescription are displayed on one screen.

Rationale – prevent misinterpretation caused by part of the prescription not being visible

Confusion can be caused by any part of the prescription not being fully visible. In general terms, this may tempt users to assume that they know what is hidden, when in fact the hidden information may not be as expected. This is a particular problem when the method of making the information visible is to scroll horizontally. Although horizontal scrolling may be useful outside medicine use (e.g. timelines), horizontal scrolling is deprecated in general web usability, and should be even more so within safety-critical healthcare IT software.

Usability testing shows that users do not notice visual cues for off-screen information that is accessible via horizontal scrolling, and as a result may overlook information. It can never be guaranteed that the hidden information will not be critically important.

Dose based

Do this:

goserelin – implant – subcutaneous – DOSE **10.8 mg** – once only

latanoprost 50 MICROg/mL – eye drops – each eye – 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

▼ **More**

Don't do this:

goserelin – implant – subcutaneous – DOSE

latanoprost 50 MICROg/mL – eye drops –

frusemide – oral – DOSE **40 mg** – twice a da

sodium chloride 0.9% – irrigation – intrave

ERYthromycin – enteric capsule – oral – D

enalapril – oral – DOSE **10 mg** – once a day i

digoxin – oral – DOSE **250 MICROg** – once a

Dose based

Do this:

goserelin • latanoprost

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

⚠ 3 more • **enalapril • digoxin**

Don't do this:

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

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9. Glossary

Active ingredient

The therapeutically active component in the medicine's final formulation that is responsible for its physiological or pharmacological action [92].

Biosimilar medicine

A biosimilar medicine or similar biological medicinal product is a version of an already registered biological medicine that has a demonstrable similarity in physiochemical, biological and immunological characteristics, efficacy and safety, based on comprehensive comparability studies. It is a copy of the original medicinal product that is usually manufactured by a different company after the innovator patent expires.

Brand name

The name given to a medicinal product by the manufacturer. The use of the name is reserved exclusively for its owner [94].

The brand name may also be referred to as a trade name and be used as part of the manufacturer's trademark for that product.

Clinical information systems

The electronic sharing of clinical information across the healthcare continuum, including electronic medication management as part of a broader suite which also includes diagnostic and pathology orders, adverse event records and discharge summaries.

Delimiter

A character that identifies the beginning or the end of a character string (a contiguous sequence of characters).

Dose-based prescribing

Prescribing or ordering medicines by expressing the active ingredient (or brand name), the required dose, the route of administration, directions for use and a start date.

This typically applies to prescribing within acute care where there is no cease date and where one or more products are administered to provide a given dose.

Dose form

The pharmaceutical form in which a product is presented for therapeutic administration (e.g. tablet, cream) [95].

Electronic medication management (eMM)

The electronic processes that safely support the sharing of medicines information across the healthcare continuum.

En dash

A punctuation mark (–) that is slightly longer than a hyphen (-).

9. Glossary

Generic medicine

A pharmaceutical product, usually intended to be interchangeable with an innovator product, that is manufactured and marketed after the expiry date of the patent or other exclusive rights [94].

A generic product is a medicine that, in comparison with the innovator medicine:

- has the same quantitative composition of therapeutically active substances, being substances of similar quality to those used in the innovator medicine
- has the same pharmaceutical form
- is bioequivalent
- has the same safety and efficacy properties [92].

The generic medicine name may also refer to the active ingredient(s) of a registered medicine in some countries, including Australia.

Innovator brand medicine

The first patented brand of the medicine, also known as the originator brand. The innovator brand may differ by country.

Label

In these guidelines, the term 'label' is used as an on-screen identifier, unless specifically indicated otherwise. It is used to describe the subsequent data item(s) and add clarity to their description, while also acting as a spacing device.

Medicine

Therapeutic goods that are represented to achieve, or are likely to achieve, their principal intended action by pharmacological, chemical, immunological or metabolic means in or on the body of a human or animal [96].

The Australian Pharmaceutical Advisory Council's guiding principles define a medicine as 'a substance given with the intention of preventing, diagnosing, curing, controlling or alleviating disease or otherwise enhancing the physical or mental welfare of people. This includes prescription and non-prescription medicines, including complementary health care products, irrespective of the administered route' [97].

Medicinal Product Unit of Use (MPUU)

The Australian Medicines Terminology MPUU is an abstract concept that defines a medicine based on the active ingredient, strength and dose form.

Medicine selection list

A list of medicines matching specified search criteria that is displayed to allow selection of a required product for prescribing, dispensing, administration or inclusion in a medicines history.

Non-breaking space

A variant of the space character that prevents an automatic line break when a new line might otherwise have occurred at the point of insertion.

9. Glossary

Pack-based prescribing

Prescribing or ordering medicines by expressing the active ingredient (or brand name), the required dose, the dosage form, strength, route of administration, directions for use and the supply quantity.

This typically applies to community prescribing or discharge prescribing from hospital, and specifies each product that is to be dispensed.

Prescription

Prescription defines all elements relating to a medicine that convey the intent of the original prescriber for the use of that medicine.

Note: This definition is for the purposes of this document and is not a legislative definition.

Salt

For the purposes of these guidelines, the term 'salt' represents any modification to a base (e.g. salt, ester, water of hydration, etc.).

Separator

A symbol, line or space used to provide differentiation between components of a medicines prescription or medicines order.

SNOMED CT®

A computer-processable clinical terminology, distributed and maintained by the International Health Terminology Standards Development Organisation.

Strength

The amount of an active ingredient contained in a defined dosage form, volume of a solution or weight of a solid.

Text wrapping

Text that does not fit into the remaining space on a line and is automatically moved to the next line.

Title case

Title case uses capital letters to start the principal words – that is, words other than articles, conjunctions and prepositions.

Trade name

See brand name.

Unit of measure

The qualifier associated with a numeric value that provides a standardised quantity.

10.1 On-screen display of units of measure

The recommendations for display of units of measure were developed from a usability perspective based on the Commission's terminology and abbreviations document, units of measure adopted by the Therapeutic Goods Administration and SNOMED CT and the unified code for units of measure (UCUM) [98]. For on-screen display, always use the form consistently as defined in this appendix, noting the following:

- Do not use plural abbreviations, except for units and description of time.
- The use of upper case and lower case in the following examples is deliberate.
- Some units of measure must not be abbreviated (e.g. nanogram).

Unit of measure	On-screen display	Notes
Centimetre	cm	
Gram	g	
Hour	hour	Use plural form where appropriate (i.e. 'hours')
International unit	unit	'Units' should always be considered to be 'International Units'. Exceptions such as ELISA units and D antigen units should be explicitly stated. Do not abbreviate. Use plural form where appropriate (i.e. 'units')
Kilogram	kg	
Litre	Litre	Do not abbreviate 'Litre' when used in isolation. Only abbreviate in a word or phrase (e.g. mg/mL, L/hour)
Mega units	Do not use	
Metre	metre	Do not abbreviate 'metre' when used in isolation. Only abbreviate in a word or phrase (e.g. sq m)
Microgram	MICROg	Do not abbreviate to mcg or μg
Microlitre	microlitre	Do not abbreviate
Micromol	micromol	Do not abbreviate
Milligram	mg	
Milligram per litre	mg/L	Abbreviate litre when used in a phrase
Millilitre	mL	Abbreviate 'Litre' when used in a word
Millimetre	mm	
Millimolar	millimolar	Do not abbreviate
Millimole	mmol	
Millimole per litre	mmol/L	Abbreviate 'Litre' when used in a phrase
Minute	minute	Use plural form where appropriate (i.e. 'minutes')
Nanogram	nanogram	Do not abbreviate
Percentage	%	
Square centimetre	sq cm	cm^2 may also be acceptable if superscript is clearly shown
Square metre	sq m	m^2 may also be acceptable if superscript is clearly shown
Unit	unit	Do not abbreviate. Use plural form where appropriate (i.e. 'units')

10. Appendices

10.2 Acceptable terminology for on-screen presentation

The following table lists the acceptable terms for on-screen presentation of medicines information. The list is a set of commonly used dose frequencies, routes of administration and dose forms. It is not intended to be exhaustive or complete.

Abbreviations may be used for 'short-cut' and 'accelerator' data entry keystrokes provided their use is not ambiguous. However, the preferred term must be displayed on-screen.

On-screen terms	Historical term
Dose frequency or timing	
once a day in the morning	morning, mane
once a day at midday	midday
once a day at night	night, nocte
once a day (preferably specifying the time of day, e.g. at night, at 8:00 pm)	daily (preferably specifying the time of day, e.g. at night, at 8 pm)
twice a day	bd
three times a day	tds
four times a day	qid
every hour[4]	hourly, every hour
every 2 hours[4]	every two hours
every 4 hours[4]	every 4 hrs, 4 hourly, 4 hrly
every 6 hours[4]	every 6 hrs, 6 hourly, 6 hrly
every 8 hours[4]	every 8 hrs, 8 hourly, 8 hrly
every 12 hours[4]	every 12 hours
every 2 days	every second day, on alternate days
once a week and specify the day in full (e.g. once a week on Tuesday)[5]	once a week
three times a week and specify the exact days in full (e.g. three times a week on Mon, Wed and Sat)	three times a week
every 2 weeks	every two weeks, per fortnight
when required	prn
immediately	stat
once	single dose
for 1 day	for one day only
for 3 days	for three days
before food	ante cibum, ac
after food	post cibum, pc
with food	cum cubus, cc
days of the week (Mon, Tue, Wed, Thu, Fri, Sat, Sun), minimum of 3 letters	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday
less than	<
greater than (alternative term 'longer than' may be used in the context of time)	>

All times should be expressed in 24-hour clock format, using a colon to separate hours and minutes. Times before midday should be appended with 'am', to remove ambiguity (e.g. 11:30 am and 23:30). Midnight and noon should be expressed as 24:00 pm and 12:00 am

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4   A maximum dosage in 24 hours must accompany a 'when required' medicines order.
5   The weekday may be abbreviated to three letters, with the first letter capitalised.

On-screen terms	Historical term
Route of administration	
buccal	buccal
in the [Left/Right/Each] ear	ear (specify left, right or each)
in the [Left/Right/Each] eye	eye (specify left, right or each)
epidural	epid
inhalation	inh
intraarticular	intraart
intradermal	id
intramuscular	IM
intraosseous	io
intrathecal	it
intranasal	in
intraperitoneal	inp
intravenous	IV
irrigation	Irrig
nebulised	NEB
nasogastric	NG
oral	PO
PEG, percutaneous enteral gastrostomy[6]	PEG
vaginal	PV
rectal	PR
PICC, peripherally inserted central catheter[6]	PICC
subcutaneous	Subcut,
sublingual	Subling
topical	top
Dose forms	
capsule	cap
cream	cream
drops	drops
ear drops	gut
ear ointment	ung
eye drops	gut
eye ointment	oculentum
injection	inj
inhaler	MDI, metered dose inhaler
mixture	mixture
ointment	oint
PCA, patient controlled analgesia[6]	PCA
pessary	pess
powder	powder
suppository	supp
tablet	tab

6   Consider mouse-over expansion or similar.

10.3 Clinical scenarios
10.3.1 Case study 1

74-year-old woman with coronary heart disease and angina. Patient has hypertension and rheumatoid arthritis

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Hospital System
Hospital Prescribing Record

Patient Identifier

Medicine List

- 10-Sep-14 **niFEDIPine** – *Adalat Oros* – modified release tablet – oral – DOSE **20 mg** – once a day – swallowed whole

- 10-Sep-14 **methotrexate** – oral – DOSE **10 mg** – once a week on Mondays

- 10-Sep-14 **piroxicam** 0.5% – gel – topical DOSE **Apply to affected area** – once a day in the morning

- 10-Sep-14 **paracetamol** – oral – DOSE **1 g** – every 6 hours

"Dose-based"

GP System
GP Prescribing Record

Patient Identifier

Ordered Medicines

- 17-Sep-14 **niFEDIPine** 20 mg – *Adalat Oros* – modified release tablet – oral – DOSE **20 mg** – once a day – swallowed whole – SUPPLY 30 – Dispense original and 1 repeats

- 17-Sep-14 **methotrexate** 10 mg – tablet – oral DOSE **10 mg** – once a week on Mondays SUPPLY 10 – Dispense original and 0 repeats

- 17-Sep-14 **piroxicam** 0.5% – gel – topical DOSE **Apply to affected area** – once a day in the morning – SUPPLY 50 g – Dispense original and 0 repeats

- 17-Sep-14 **paracetamol** 500 mg – tablet – oral DOSE **1 g** – every 6 hours – SUPPLY 100 – Dispense original and 0 repeats

(Order)

"Pack-based"

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eHealth Record
Community Dispense Record

Patient Identifier

Dispensed Medicines

- 17-Sep-14 **niFEDIPine** 20 mg – *Adalat Oros* – modified release tablet – oral – DOSE **Take 1 tablet** – once a day – swallowed whole – SUPPLY 30 – Original dispense

- 17-Sep-14 **methotrexate** 10 mg – *Methoblastin* – tablet – oral – DOSE **Take 1 tablet** – once a week on Monday – SUPPLY 10 – Original dispense

- 17-Sep-14 **piroxicam** 0.5% – *Feldene* – gel – topical – DOSE **Apply to the affected area** – once a day in the morning – SUPPLY 50 g – Original dispense

- 17-Sep-14 **paracetamol** 500 mg – *Panadol* – tablet – oral – DOSE **Take 2 tablets** – every 6 hours – when required for pain relief – do not take more than 8 in 24 hours – SUPPLY 100 – Original dispense

"Pack-based"

10.3.2 Case study 2

60-year-old man with type 2 diabetes and dyslipidaemia

Hospital System
Hospital Prescribing Record

Patient Identifier

Medicine List

09-Sep-14 **metformin hydrochloride** – oral –
DOSE **1 g** – twice a day

09-Sep-14 **insulin glargine** 100 units/mL – *Lantus
Solostar* – injection – subcutaneous
DOSE **18 units** – once a day at bed time

09-Sep-14 **insulin lispro** 100 units/mL – *Humalog
Kwikpen* – injection – subcutaneous
DOSE **5 units** – before meals

09-Sep-14 **atorvastatin** – oral – DOSE **10 mg** – once a
day at night

"Dose-based"

GP System
GP Prescribing Record

Patient Identifier

Ordered Medicines

16-Sep-14 **metformin hydrochloride** 1 g – tablet –
oral – DOSE **1 g** – twice a day – SUPPLY 90 –
Dispense original and 0 repeats

16-Sep-14 **insulin glargine** 100 units/mL – *Lantus
Solostar* – injection – subcutaneous
DOSE **18 units** – once a day at bed time –
SUPPLY 5 x 3 mL cartridges – Dispense
original and 0 repeats

16-Sep-14 **insulin lispro** 100 units/mL – *Humalog
Kwikpen* – injection – subcutaneous
DOSE **5 units** – before meals
SUPPLY 5 x 3 mL cartridges – Dispense
original and 0 repeats

16-Sep-14 **atorvastatin** 10 mg – tablet – oral
DOSE **10 mg** – once a day at night
SUPPLY 30 – Dispense original and 0 repeats

[Order]

"Pack-based"

eHealth Record
Community Dispense Record

Patient Identifier

Dispensed Medicines

16-Sep-14 **metformin hydrochloride** 1 g –
Diabex-1000 – tablet – oral
DOSE **Take 1 tablet** – twice a day
SUPPLY 90 – Original dispense

16-Sep-14 **insulin glargine** 100 units/mL – *Lantus
Solostar* – injection – subcutaneous
DOSE **Inject 18 units** – once a day at
bed time – SUPPLY 5 x 3 mL cartridges –
Original dispense

16-Sep-14 **insulin lispro** 100 units/mL – *Humalog
Kwikpen* – injection – subcutaneous
DOSE **Inject 5 units** – before meals
SUPPLY 5 x 3 mL cartridges – Original
dispense

16-Sep-14 **atorvastatin** 10 mg – *Lipitor* – tablet – oral
DOSE **Take 1 tablet** – once a day at night
SUPPLY 30 – Original dispense

"Pack-based"

10. Appendices

10.3.3 The relationship between the on-screen display of medicines information and the Australian Medicines Terminology

The Australian Medicines Terminology (AMT) [59] allows unique and unambiguous identification of all commonly used medicines in Australia and is a national extension of the strategic terminology SNOMED CT-AU (the Australian release of SNOMED CT) [101]. It can be implemented in clinical information systems to support activities such as:

- prescribing
- recording
- review
- supply, including dispensing
- administration
- transfer of information between systems.

An overview is available at the NEHTA website [62], along with resources and guidance [99].

AMT concepts normally describe medicines by their active ingredient name(s) or by brand name. In certain cases, additional information is included in descriptions when required for safety reasons. For example, descriptions of Coveram brand products also include the active ingredients ordered according to the strength cited in the brand name. These predefined concepts may be used for multiple purposes, including the population of selection lists, to facilitate prescribing, dispensing and medicine administration recording. Always use the preferred term (as opposed to the fully specified term) in on-screen display.

The concept descriptions present all the information required to define the components of a specific medicine. Examples of Medicinal Product Unit of Use (MPUU) concept descriptions are:

- amoxycillin 500 mg capsule
- diclofenac sodium 50 mg tablet.

In these examples, the active ingredient, the amount of active ingredient and the dose form are described in one term.

Trade Product Unit of Use (TPUU) concept descriptions for the MPUUs above proposed in AMT are:

- Amoxil 500 mg capsule
- Voltaren 50 mg tablet.

10.4 Human factors assessment

Human factors assessment was undertaken on recommendations within the guidelines that carried ambiguity. Twelve questions were identified and, for each, a number of display solutions were developed and subjected to heuristic evaluation. These display solutions were chosen as plausible alternative recommendations relevant to each of the key questions. A panel of human factors experts was recruited to evaluate which solution or solutions ought to be recommended as best practice (or to recommend that a different approach ought to be taken with respect to a particular guideline).

Example prescriptions were provided by the Commission to allow the development of simulated on-screen interface screenshots of each of the display solutions to inform the evaluators' deliberations. The alternative solutions were evaluated with reference to three sets of published heuristics for user interface design [69] [76] [100]. All of the panel members had prior experience in medical human factors research, and discrepancies between evaluators' judgements were resolved through discussion.

A summary of the heuristic evaluation, including advantages and disadvantages of each of the alternative solutions for the 12 research questions, is presented in the final human factors assessment report [76]. This report provides background relevant to each question, lists each of the alternative solutions to each question considered by the panel, and provides a summary of the panel's conclusions. Where applicable, explanations are provided as to why particular options were not preferred. For each research question, the solution recommended by the expert panel has, in all cases, been incorporated into these guidelines.

The Commission acknowledges that there are limitations to the heuristic evaluation in that it has no empirical foundation and is based on inspection of a limited set of exemplars in a limited range of contexts. Further research to examine each recommendation in more detail could include:

- an expanded task analysis using prescription software. The range of contexts investigated could be expanded to include pharmacist-centred tasks (hospital and community based) and drug administration contexts beyond the inpatient hospital-based situation.
- rapid prototyping of alternative software interfaces and conducting informal usability trials to assess the apparent usability of alternative design options. The simulations could vary in fidelity from mock-up screenshots (as used in the present project) to interactive software simulations or real prescription systems (tested using simulated patient data).
- controlled behavioural experiments to test all recommendations empirically. Heuristic evaluation is a qualitative method and hence conclusions should not be regarded as definitive. To address this issue, empirically based evidence for best practice should be sought in future work [76].

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7   Capitalised imperatives in these rules should be interpreted as per RFC 2119 [102].

10. Appendices

10.5 Recommendations for wrapping medicines information

Recommendations for wrapping of coded clinical data displayed by clinical information systems are provided for presentation of medicines information deemed to be 'long' by comparison with available display.

This guidance is intended to be applicable to SNOMED CT-AU and the AMT, but may also apply to other terminologies in use.

In keeping with the scope of this document, these recommendations apply to all human readable display outputs of clinical information systems, but do not apply to the storage and retrieval of clinical codes and descriptions:

- During data entry, the full (i.e. non-truncated) description of the chosen clinical code MUST[7] have been displayed so that it can be medico-legally 'accepted' at some point in the data entry process.
- The description 'accepted' during data entry (whether preferred term or synonym) MUST be available for display by all systems holding this data, in perpetuity (i.e. exactly as 'accepted').
    - o In some cases, it may be possible that the description 'accepted' at the point of data entry will not be a preferred term or native synonym (i.e. an 'interface terminology' will have been used for data entry purposes).
    - o It is assumed, for the purposes of this appendix, that any agreed use of interface terminologies have been previously reviewed for clinical correctness and safety across the end-to-end process, so that their use does not introduce ambiguity to patient records.
    - o Precise, detailed rules for the safe use of interface terminologies are out of scope of this appendix.
- The first two rules MUST apply both to the display of 'native' descriptions of clinical codes within systems, and to those descriptions and codes when messaged to other systems, and subsequently used within them.
- Truncation MUST NOT occur in the display of medicines descriptions (e.g. of SNOMED CT-AU [101] or AMT concepts).
- Clinical content MUST NOT be separated from its label (see Section 6.4.1).
- Hyphenation, or any other punctuation marks (over and above any already present), MUST NOT be added to a description of a clinical code for display purposes.
- Words within the code's description MUST NOT be fragmented for display purposes. If words used within a description are conjoined by hyphens, then these MUST NOT be taken as points for wrapping.

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- Australian Medicines Handbook
- Australian Nursing and Midwifery Federation
- Australian Patient Safety Foundation
- Clinical Skills Development Service
- E-health Australian Institute of Health Innovation
- Medical Software Industry Association
- National E-Health Transition Authority
- NHMRC Centre of Research Excellence in Informatics
- NPS MedicineWise
- Pharmacy Guild of Australia
- Pharmaceutical Society of Australia
- public and private, acute, primary and ambulatory health services
- Royal Australian College of General Practitioners
- Royal College of Pathologists of Australasia
- Society of Hospital Pharmacists of Australia
- state and territory jurisdictions
- Therapeutic Goods Administration
- University of Queensland (School of Psychology and School of Medicine).

Australian Commission on Safety and Quality in Health Care
Level 5, 255 Elizabeth Street SYDNEY NSW 2000
GPO Box 5480 SYDNEY NSW 2001

Telephone: (02) 9126 3600
Fax: (02) 9126 3613

mail@safetyandquality.gov.au
www.safetyandquality.gov.au

AUSTRALIAN COMMISSION
ON SAFETY AND QUALITY IN HEALTH CARE