

Design Guidance Exploration

Abbreviations and Acronyms

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PREFACE

Documents replaced by this document

Document Title	Version
None	

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Design Guidance Exploration – Abbreviations and Acronyms in Free Text Input	1.0.0.0

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1 INTRODUCTION

This document presents design exploration and early design guidelines for how clinical applications should handle abbreviations and acronyms in input and display fields. This design information uses principles from reviews of relevant literature, best practices and published glossaries, and draws on the current thinking within safety critical systems.

This document also suggests areas for future research. This research and prototyping would allow further validation of some of the early design guidance given.

1.1 Summary of Recommendations

The design exploration illustrates early recommendations for how clinical applications should manage abbreviations and acronyms. Clinical applications should:

- Require the user to resolve known dangerous abbreviations and acronyms, especially when a user enters information as free text
- Avoid abbreviations, or provide readily accessible explanations, when displaying labels (screen text)
- Present abbreviation punctuation and capitalisation consistently

1.2 Recommendations Requiring Future Research

Research should be performed to validate these recommendations listed in section 1.1.

In addition to these, see the document *Design Guidance Exploration – Abbreviations* and *Design Guidance Exploration – Acronyms in Free Text Input {R1}*.for information on recommendations for future research on abbreviations in free text input. In summary, these include:

- The use of an interface to alert the user entering the information, who can then resolve any unexpanded abbreviations and acronyms
- The provision of warnings for any remaining unexpanded abbreviations and acronyms when users view this information

2 SCOPE

The following figure illustrates the scope of work included in this document, and how it fits into the overall field of abbreviations and acronyms:

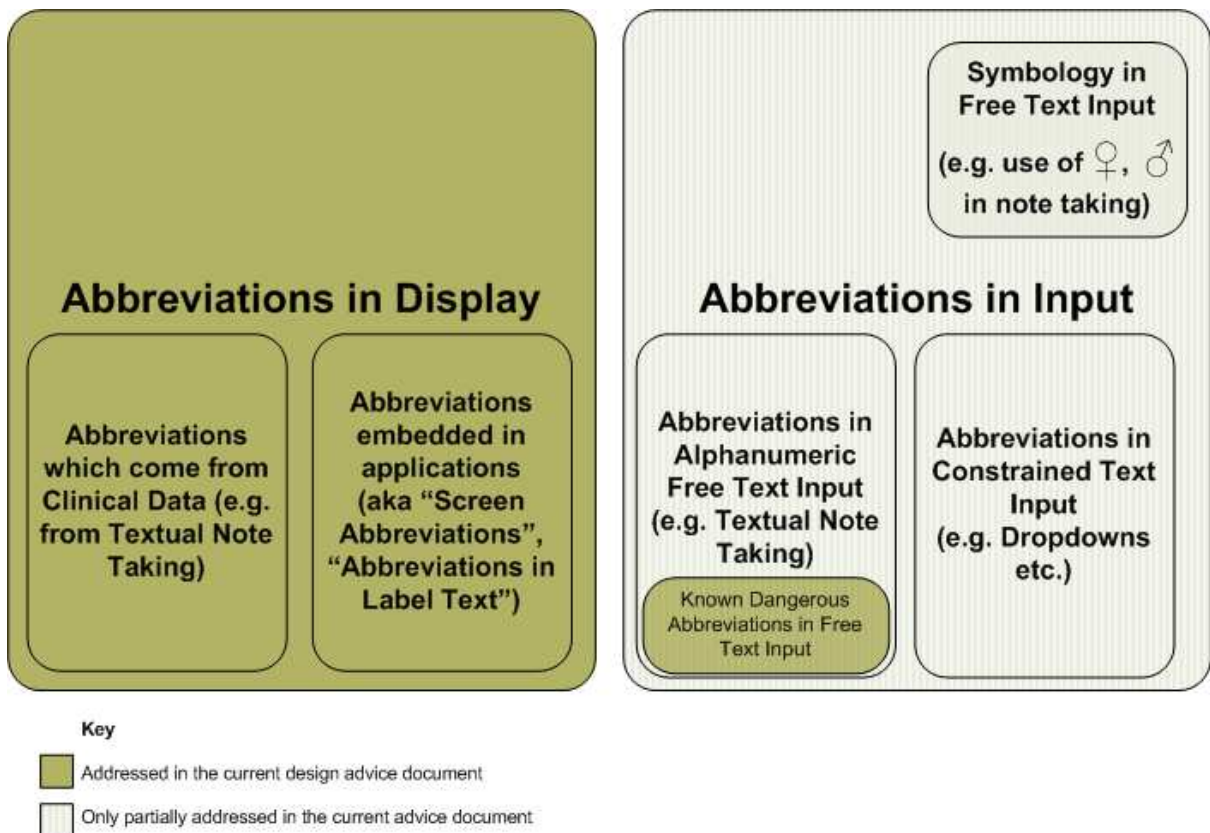


Figure 1: Taxonomy of Abbreviations and Acronyms, Showing Scope of Work

As Figure 1 illustrates, there are some areas that still require the identification of fully-validated recommendations for input abbreviations. However, this document presents design guidance for display abbreviations, and a specific subset of input abbreviations relating to known dangerous abbreviations. Future releases of this document will cover other areas of input abbreviation handling. See also the document *Design Guidance Exploration – Abbreviations and Acronyms in Free Text Input {R1}* for further advice on input abbreviations.

3 GUIDELINES ON ABBREVIATION AND ACRONYM USAGE

This section presents each of the key guidelines on abbreviation and acronym usage that result from current research. The key guidelines will:

- Require the user to resolve all known dangerous abbreviations and acronyms
- Avoid, or explain, abbreviations and acronyms
- Present abbreviations and acronyms consistently

3.1 Require the User to Resolve all Known Dangerous Abbreviations and Acronyms

When accepting free text input which includes abbreviations, applications should require the user to resolve all known dangerous abbreviations and acronyms.

3.1.1 Recommendations

Applications which provide free text input, for example for note taking, should:

- Alert the user authoring the text to the presence of known forbidden/dangerous abbreviations and acronyms (see below for a definition of these) whenever the author moves from one input field to another
- Present potential expansions for selection where possible, but not provide a default expansion
- Prevent the storage of known forbidden/dangerous abbreviations and acronyms in their unexpanded form under all circumstances

The current guidance assumes the following definition of a forbidden/known dangerous abbreviation or acronym: 'one which is categorised as such by an appropriate authority'. An abbreviation or acronym might be considered dangerous for several equally valid reasons:

- Confusion with another acronym or abbreviation, with potential patient safety consequences
- Relation to drugs, for example, drug names, dose amounts, dose frequencies and so on
- Misinterpretation in some other way which might affect patient safety, or be unsafe for some other reason
- It has caused a dangerous incident in the past

The process of collating and validating the list of forbidden/dangerous acronyms will be an ongoing one, and this design guidance does not prescribe how it should be achieved, or by what authority, although initial sources for the list are suggested (see section 3.1.3) based on primary and secondary research.

3.1.2 Accessibility

The detailed accessibility considerations for this design guidance will depend on the precise design adopted to adhere to the advice given. However, several issues will have to be addressed by any design:

- The interaction design for alerting the user to the presence of dangerous unexpanded items, and allowing users to select the next dangerous unexpanded item, will have to be usable by screen reader users and those who prefer or require keyboard or other input devices rather than mouse input
- The interaction design for distinguishing between non-dangerous and dangerous unexpanded items will need to use more than colour to do so

3.1.3 Justification

Some forms of abbreviation and acronym are known to be dangerous from specific experiences. The US National Patient Safety Guidelines (NPSG) Goal 2b¹ mandates a list of forbidden/dangerous abbreviations which is enforced by the audit of patient notes for all accredited institutions. This list is deliberately constrained to those items which have caused incidents in the past, and it is therefore beneficial to avoid using the items on it. It is also clearly evidence-based. The list is reproduced in APPENDIX A

It is well recognised that the abbreviation of drug names, dosage amounts, and dose frequency, is dangerous. The US Institute for Safe Medication Practices (ISMP) maintains a list of known dangerous drug-related abbreviations and acronyms which the NPSG references. This list is reproduced in APPENDIX B.

In addition to these secondary sources, approximately 4500 abbreviations and acronyms, in use within the healthcare industry, have been collated and categorised. The data has been analysed for collisions between acronym and abbreviation definitions, in particular looking for collisions between clinical terms or other items which might cause dangerous misinterpretation. This has revealed around 30 potentially dangerous acronyms which are also candidates for inclusion on a list of forbidden/dangerous abbreviations and acronyms.

3.1.4 Patient Safety

Observation of this guideline is critically important to patient safety. If applications do not resolve all known dangerous abbreviations and acronyms at input time, then clinicians may:

- Enter text into a clinical application which may be dangerously misleading or ambiguous to other application users
- View information in clinical applications containing potentially dangerous abbreviations and acronyms
- Receive no warning when reading medical text that potentially dangerous abbreviations and acronyms are present, and may act on a mistaken impression of the intent of the author of the text, with possible negative consequences for patients

This confusion could have unintended or hazardous results, for example:

- Patients receiving the wrong drug or an incorrect dosage
- Incorrect patient administration or clinical interaction due to mistaken abbreviations

APPENDIX A and APPENDIX B provide more details of other possible dangerous conflicts.

3.2 Avoid or Explain Abbreviations and Acronyms

Applications should avoid abbreviations where possible. If it is not possible to avoid using an acronym, the user should have easy access to an explanation of the acronym's meaning.

3.2.1 Recommendations

Applications which display labels (static text displayed by an application, for example, next to a form field to indicate what the field contains (also known as 'Screen Text') should:

- Avoid using abbreviations and acronyms wherever possible. This is the preferred approach
- Use abbreviations and acronyms when screen space constraints would lead to horizontal scrolling or clipping of the text if the fully expanded form were used instead

¹ Joint Commission International Center for Patient Safety: NPSG 2B Patient Safety Practices related to Patient Safety Goal {R2}: <http://www.jcipatientsafety.org/22842/>

- Use abbreviations and acronyms when clear evidence exists that they are universally used or accepted in the target context for the application, and are more usable in their contracted forms
- Avoid using known dangerous abbreviations and acronyms regardless of screen or other constraints
- Provide a method of discovering the local meaning of the abbreviation or acronym where it is not possible to avoid use, unless the user explicitly opts not to display this discovery method

Methods for discovering the local meaning of an abbreviation or acronym must be:

- Simple to use
- Quick to use
- Accessible to all users (for example, through a glossary link or other form of user assistance)

3.2.2 Examples

Figure 2 shows several views which conform to the recommendations in this document.

Note

These views do not dictate a particular interaction, but merely illustrate interactions which comply with the design guidance given.

“Screen/Label” Text Assistance for Abbreviations

This figure shows part of a table in an hypothetical application, illustrating the use of a screen text abbreviation in the table header, together with tip-text with a glossary/help link to an expansion in addition to the tip-text. If the user clicked on the link, a glossary would display which contained an expansion of the abbreviation (so the expansion is not provided solely via the tip-text)

Column 1	Column 2	ENT
1	Item 1	Ears Nose and Throat
3	Item 2	No
4	Item 3	Unknown

Ideal expansion of abbreviation in clinical free text input (n.b. this expansion would be inserted AT INPUT TIME)

ENT (Ears Nose and Throat)

Figure 2: Example Views Illustrating Explanation of an Abbreviation

3.2.3 Accessibility

When providing assistance for expanding abbreviations, applications must expose the explanation of the abbreviation in a manner which is accessible to all users, including users of assistive technologies such as screen readers, users with limited manual dexterity and users with low vision.

In particular it is not safe for an application to rely on tooltips alone as a means of providing expansions, because:

- They cannot be used by non-mouse users
- It may be difficult for those with low vision to read them since they do not resize with other text in a Web context
- Those with limited manual dexterity may find them difficult to access

3.2.4 Justification

Complexity is a well known source of human error (see, for example, the reference to “Thomas Nolan” in *System changes to improve patient safety {R4}*). In this case, it is clear that more mental effort is required for a user to expand an abbreviation or acronym than would be required to read the fully expanded form directly. This added effort (increased cognitive load) increases the risk of the user making a mistake in using the data presented, and makes mistakes in other activities more likely. In addition, in common with other usages, the potential for ambiguity exists whenever abbreviations and acronyms are employed.

However, it will not always be possible to display a fully expanded version of a long label, for example, where screen space is at a premium, or the alternative to abbreviation would be horizontal scrolling. In these cases, it is important to mitigate the ambiguity risk by providing the user with access to the correct expansion.

Using the expanded form of an abbreviation will not be the best approach when it is clear (for example, from the user's context) that they do not benefit from the expansion. This can arise because they are very familiar with the abbreviated form and will read and recognise it more quickly than the expanded form. In these cases the user's cognitive load and reading time may be increased rather than decreased by the presence of the expanded form. When this argument is used for including an abbreviation, it must be substantiated by clear evidence of the common usage and understanding of the abbreviation in question however.

3.2.5 Patient Safety

These guidelines are important because if they are not observed:

- Abbreviations and acronyms will be used unnecessarily, adding to the increased cognitive load of users and making user errors more likely
- When abbreviations and acronyms do need to be used, users will not be able to determine the correct meaning of acronyms they find and may make incorrect assumptions about the meaning, leading to error

3.3 Present Abbreviations and Acronyms Consistently

When displaying abbreviations and acronyms, applications should always present them consistently with respect to capitalisation and punctuation.

3.3.1 Recommendations

Applications which display acronyms or abbreviations should:

- Present all acronyms (phrases reduced to their initial letters only) in UPPERCASE with no punctuation marks and no interior spaces, for example, ENT for Ears, Nose and Throat rather than E N T, ent or E.N.T.
- Present all abbreviations (phrases truncated to two or more letters of their component words) with every word or abbreviated word capitalised, and all truncated words punctuated with a full stop and no interior spaces, for example, Tib.Ant. for Tibialis Anterior, rather than TibAnt, Tib. Ant. , tibant or tib ant)

4 ACCESSIBILITY

The punctuation convention proposed may cause some difficulty for screen reader users. Some screen readers read out the acronym as a phrase, rather than pronouncing its individual letters (for example, ENT may be pronounced as the word 'ent' rather than as the separate letters E N T). This suggests that a punctuated form with separators (E.N.T.) would be more accessible to screen reader users. However, any such suggestion needs to be weighed against the consequence of introducing an unfamiliar form to non-reader users, and the fact that screen reader users may already be very familiar with the 'word forms' of common acronyms because of current usage. User research should be performed to optimise the recommendation.

In some circumstances it will be possible to mark the acronym as being an acronym in a machine-readable form, allowing assistive technologies, such as readers, to take appropriate action, such as reading out the letters individually. In HTML Web applications, this is achieved using the ACRONYM or ABBR tags. However, some current readers do not interpret these representations correctly, so it is important that any recommendation stands independent of them.

4.1.1 Justification

Consistent presentation always enhances readability, and reduces the complexity of user interactions with the application interface. Reduced complexity enhances the safety of user interactions with the application.

Consistent presentation is particularly important with abbreviations, since the user has to cope with the process of expanding the abbreviation. Inconsistent presentation adds another mental hurdle and contributes to usage errors, therefore slowing the processing of patient information.

For these reasons, a set of guidelines for presentation, which is consistent with common usage in glossaries found in within sections of the healthcare industry, is being proposed. This common usage is derived from observations made during the survey of approximately 4500 abbreviations and acronyms in use within the UK healthcare industry. The rationale for following common usage is that the forms of presentation used should be familiar to clinicians, and therefore yield the best chance of minimising the complexity of the display to the user.

4.1.2 Patient Safety

These guidelines are important because if they are not observed:

- Abbreviations and acronyms will be presented in many differing forms from application to application, adding to the cognitive load of users and making user errors more likely
- Users will be more likely to misinterpret the acronyms or abbreviations if they are not presented consistently

5 TAXONOMY OF ABBREVIATION AND ACRONYM USAGE

It is helpful in thinking about abbreviation and acronym usage to organise their potential uses into categories for consideration, each of which has its own set of requirements and issues. Table 1 presents a simple taxonomy for observations in relation to abbreviations and acronyms.

Major Category	Sub-Category	Observations
Input	Free Text (for example, Note Taking)	Any text may be entered. Impeding the flow of text input to expand abbreviations will dramatically reduce usability.
Input	Constrained Text (for example, drop down boxes and radio button lists)	Rules can be similar to display of label text. Capable of being much more inherently safe than free text input of the same data with respect to abbreviation risks.
Display	Label text	Often possible to avoid abbreviation altogether, and always possible to provide assistance to explain those abbreviations which are necessary.
Display	User-input text	Reduction of ambiguity hinges on good input validation to remove ambiguity and highlight the remaining ambiguous text.
Special	Drug-related information (for example, units of measure and dosages)	Scenarios where this data type is frequently exchanged (for example prescribing) should be considered for special user interface (UI) treatment to avoid some of the most common hazardous abbreviations. However, this sort of data often finds its way into free text notes where constraints are more difficult to enforce.

Table 1: Simple Taxonomy for Observations in Relation to Abbreviations and Acronyms

6 RESEARCH AND PROTOTYPING

The design guidance provided in this document is based on current research. However, in some cases this research is not sufficient to justify the recommendations completely.

The potential design approach that the document *Design Guidance Exploration – Abbreviations and Acronyms in Free Text Input {R1}* provides is based on general safety system design principles and requires further work to justify.

The following items of research and prototyping are proposed in order to strengthen the research base for the design advice given. Some of the items can logically be undertaken by Microsoft®, but others require specialist clinician involvement in their organisation, execution and analysis.

6.1 Proposed Primary Research

This section details items of primary research. It is expected that they are likely to need specialist clinician involvement in their organisation, execution and analysis.

6.1.1 Review of Current Practice in Ambiguity Resolution

A key tenet of the proposal for free text input is that systems will be made safer if readers of notes are provided with information which:

- As far as possible, contain fully expanded renderings of all abbreviations and acronyms used
- Contains NO known dangerous abbreviations
- Warns them about the presence of unexpanded abbreviations and acronyms where expansion has not been possible

In order to prove the value of these proposals, particularly the last one, data should be collected on how clinicians in different scenarios currently resolve ambiguity which is present in paper medical records and notes, for example during handovers. This will show whether a system which can help quick recognition of ambiguity would be as helpful as anticipated.

6.1.2 Review of Proposed Forbidden or Dangerous Abbreviations and Acronyms

The same research subject group used to prove the proposals identified in section 6.1.1 could also be used to gather data on candidate dangerous/forbidden abbreviations to validate them.

An ongoing piece of work will be required to update the list, based on any adverse events involving abbreviation.

6.1.3 Ensuring Consistency of Approach with Medical Terminology Handling

For many systems, it will be necessary to arrive at an approach for handling the input of notes and their transformation into systematic medical terminology (for example, coding for SNOMED-CT) which solves the same problem of resolving ambiguous input into unambiguous output. Whatever approach is adopted for free text handling regarding abbreviations and acronyms, the approach taken for terminology coding must be the same for consistency.

7 DOCUMENT INFORMATION

7.1 Terms and Abbreviations

Abbreviation	Definition
UI	User Interface

Table 2: Terms and Abbreviations

7.2 Nomenclature

This section shows how to interpret the different styles used in this document to denote various types of information.

7.2.1 Body Text

Text	Style
Code	Monospace
Script	
Other markup languages	
Interface dialog names	Bold
Field names	
Controls	
Folder names	Title Case
File names	

Table 3: Body Text Styles

7.2.2 Cross References

Reference	Style
Current document – sections	Section number only
Current document – figures/tables	Caption number only
Other project documents	<i>Italics</i> and possibly a footnote
Publicly available documents	<i>Italics</i> with a footnote
External Web-based content	<i>Italics</i> and a hyperlinked footnote

Table 4: Cross Reference Styles

7.3 References

Reference	Document	Version
R1.	Design Guidance Exploration – Abbreviations and Acronyms in Free Text Input	1.0.0.0
R2.	Joint Commission International Center for Patient Safety: NPSG 2B Patient Safety Practices related to Patient Safety Goal {R2}: http://www.jcipatientsafety.org/22842/	
R3.	US Institute for Safe Medication Practices Special Issue: "Do Not Use These Dangerous Abbreviations or Dose Designations" http://www.ismp.org/Newsletters/acutecare/articles/20030220_2.asp?ptr=y	
R4.	System changes to improve patient safety, Thomas W Nolan, BMJ 2000;320:771-773 (18 March) http://bmj.bmjournals.com/cgi/content/full/320/7237/771	
R5.	Institute of Safe Medical Practice Website http://www.ismp.org/Newsletters/acutecare/articles/20030220_2.asp	

Table 5: References

APPENDIX A JOINT COMMISSION ON ACCREDITATION OF HEALTHCARE ORGANISATIONS (US)

The information given in Table 6 is from the Official "Do Not Use" List from the Joint Commission International Center for Patient Safety: NPSG 2B Patient Safety Practices related to Patient Safety Goal {R2}.

Do Not Use	Potential Problem	Preferred Term
U (unit)	Mistaken for "0" (zero), the number "4" (four) or "cc"	Write "unit"
IU (International Unit)	Mistaken for IV (intravenous) or the number 10 (ten)	Write "International Unit"
Q.D., QD, q.d., qd (daily) Q.O.D., QOD, q.o.d., qod (every other day)	Mistaken for each other Period after the Q mistaken for "I" and the "O" mistaken for "I"	Write "daily" Write "every other day"
Trailing zero (X.0 mg)* Lack of leading zero (.X mg)	Decimal point is missed	Write X mg Write 0.X mg
MS MSO4 and MgSO4	Can mean morphine sulfate or magnesium sulfate Confused for one another	Write "morphine sulfate" Write "magnesium sulfate"

Table 6: Excerpt from the Official "Do Not Use" List

Table 7 provides additional abbreviations, acronyms and symbols (for possible future inclusion in the Official "Do Not Use" List).

Do Not Use	Potential Problem	Use Instead
> (greater than) < (less than)	Misinterpreted as the number "7" (seven) or the letter "L" Confused for one another	Write "greater than" Write "less than"
Abbreviations for drug names	Misinterpreted due to similar abbreviations for multiple drugs	Write drug names in full
Apothecary units	Unfamiliar to many practitioners Confused with metric units	Use metric units
@	Mistaken for the number "2" (two)	Write "at"
cc	Mistaken for U (units) when poorly written	Write "ml" or "millilitres"
µg	Mistaken for mg (milligrams) resulting in one thousand-fold overdose	Write "mcg" or "micrograms"

Table 7: Additional Abbreviations and Acronyms for Possible Future Inclusion in the Official "Do Not Use" List

APPENDIX B INSTITUTE OF SAFE MEDICAL PRACTICE (US)

The following table of dangerous abbreviations or dose designations is from the Institute of Safe Medical Practice Website {Error! Reference source not found.} at:
http://www.ismp.org/Newsletters/acutecare/articles/20030220_2.asp

Abbreviation/ Dose Expression	Intended Meaning	Misinterpretation	Correction
Apothecary symbols	dram minim	Misunderstood or misread (symbol for dram misread for "3" and minim misread as "mL").	Use the metric system.
AU	aurio uterque (each ear)	Mistaken for OU (oculo uterque—each eye).	Don't use this abbreviation.
D/C	discharge discontinue	Premature discontinuation of medications when D/C (intended to mean "discharge") has been misinterpreted as "discontinued" when followed by a list of drugs.	Use "discharge" and "discontinue."
Drug names			Use the complete spelling for drug names.
ARA°A	vidarabine	cytarabineARA°C	
AZT	zidovudine (RETROVIR)	azathioprine	
CPZ	COMPAZINE (prochlorperazine)	chlorpromazine	
DPT	DEMEROL- PHENERGAN- THORAZINE	diphtheria-pertussis-tetanus (vaccine)	
HCl	hydrochloric acid	potassium chloride (The "H" is misinterpreted as "K.")	
HCT	hydrocortisone	hydrochlorothiazide	
HCTZ	hydrochlorothiazide	hydrocortisone (seen as HCT250 mg)	
MgSO ₄	magnesium sulfate	morphine sulfate	
MSO ₄	morphine sulfate	magnesium sulfate	
MTX	methotrexate	mitoxantrone	
TAC	triamcinolone	tetracaine, ADRENALIN, cocaine	
ZnSO ₄	zinc sulfate	morphine sulfate	
Stemmed names			
"Nitro" drip	nitroglycerin infusion	sodium nitroprusside infusion	
"Norflox"	norfloxacin	NORFLEX	
m g	microgram	Mistaken for "mg" when handwritten.	Use "mcg."
o.d. or OD	once daily	Misinterpreted as "right eye" (OD—oculus dexter) and administration of oral medications in the eye.	Use "daily."
TIW or tiw	three times a week.	Mistaken as "three times a day."	Don't use this abbreviation.
per os	orally	The "os" can be mistaken for "left eye."	Use "PO," "by mouth," or

Abbreviation/ Dose Expression	Intended Meaning	Misinterpretation	Correction
			"orally."
q.d. or QD	every day	Mistaken as q.i.d., especially if the period after the "q" or the tail of the "q" is misunderstood as an "i."	Use "daily" or "every day."
qn	nightly or at bedtime	Misinterpreted as "qh" (every hour).	Use "nightly."
qhs	nightly at bedtime	Misread as every hour.	Use "nightly."
q6PM, etc.	every evening at 6 PM	Misread as every six hours.	Use 6 PM "nightly."
q.o.d. or QOD	every other day	Misinterpreted as "q.d." (daily) or "q.i.d. (four times daily) if the "o" is poorly written.	Use "every other day."
sub q	subcutaneous	The "q" has been mistaken for "every" (for example, one heparin dose ordered "sub q 2 hours before surgery" misunderstood as every 2 hours before surgery).	Use "subcut." or write "subcutaneous."
SC	subcutaneous	Mistaken for SL (sublingual).	Use "subcut." or write "subcutaneous."
U or u	unit	Read as a zero (0) or a four (4), causing a 10-fold overdose or greater (4U seen as "40" or 4u seen as "44").	"Unit" has no acceptable abbreviation. Use "unit."
IU	international unit	Misread as IV (intravenous).	Use "units."
cc	cubic centimetres	Misread as "U" (units).	Use "mL."
x3d	for three days	Mistaken for "three doses."	Use "for three days."
BT	bedtime	Mistaken as "BID" (twice daily).	Use "hs."
ss	sliding scale (insulin) or ½ (apothecary)	Mistaken for "55."	Spell out "sliding scale." Use "one-half" or use "½."
> and <	greater than and less than	Mistakenly used opposite of intended.	Use "greater than" or "less than."
/ (slash mark)	separates two doses or indicates "per"	Misunderstood as the number 1 ("25 unit/10 units" read as "110" units).	Do not use a slash mark to separate doses. Use "per."
Name letters and dose numbers run together (for example, Inderal40 mg)	Inderal 40 mg	Misread as Inderal 140 mg.	Always use space between drug name, dose and unit of measure.
Zero after decimal point (1.0)	1 mg	Misread as 10 mg if the decimal point is not seen.	Do not use terminal zeros for doses expressed in whole numbers.
No zero before decimal dose (.5 mg)	0.5 mg	Misread as 5 mg.	Always use zero before a decimal when the dose is less than a whole unit.

Table 8: Dangerous Abbreviations or Dose Designations