AUSTRALIAN COMMISSION ON SAFETY AND QUALITY IN HEALTH CARE

National Standard for the Application of Tall Man Lettering: Project Report

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The Commission acknowledges the work of the NSW Clinical Excellence Commission in development of this national standard and, in particular, Mr Daniel Lalor.

It also acknowledges the work of Associate Professor Lynne Emmerton and Dr Mariam Rizk from the School of Pharmacy at The University of Queensland. Their work included assembling the foundations of the Australian look-alike, sound-alike medicines list as well as ongoing contributions to the project.

All stakeholders (as listed under Part 5 Consultation) who contributed to discussions and development of the project are acknowledged and thanked for their work.

Clinicians who gave of their time to take part in the risk assessment process provided an invaluable contribution to this project and are greatly thanked.

Finally, the Commission acknowledges the many researchers, health professionals and consumers that contributed to identification of look-alike, sound-alike medicine names and to strategies for managing patient risk associated with them.

This paper is available on the Commission web site at www.safetyandquality.gov.au

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Context

It is reported that medicine name confusion contributes to thousands of medication errors each year,[1] some causing significant patient harm.[2] Numerous lists of confusable medicine names have been published in Australia and overseas.[3-6] These lists highlight the similarities between many pairs and groups of medicines currently marketed.

Tall Man lettering is a typographic technique that uses selective capitalisation to help make similar looking medicine names more easily differentiable.[7-9]

The Australian Commission on Safety and Quality in Health Care (The Commission) supports the use of Tall Man lettering as part of a multi-faceted approach to reduce the risks associated with confusable medicine names. Other interventions, such as the use of bar-code verification and thorough pre-market assessment processes also make valuable contributions to overall risk reduction and should be pursued by health care providers.

Project background

In late December, 2009, the Australian Commission on Safety and Quality in Health Care (the Commission) received a letter from the Department of Human Services, Victoria, asking that the Commission give consideration to development of a national standard for Tall Man lettering. It was suggested that such a national standard would allow incorporation of Tall Man lettering into the National E-Health Transition Authority's Australian Medicines Terminology, and would facilitate use of the technique more widely in Australia. The view presented by the Department of Human Services was supported by the Commission's Medication Reference Group (representing peak bodies, clinicians, consumers and other subject matter experts), Inter-Jurisdictional Committee (representing Commonwealth, states and territories) and Private Hospital Sector Committee (representing private hospital owners, managers, funders and clinicians).

The objectives of developing a national standard for Tall Man lettering are to:

- Prevent the proliferation of various lists of Tall Man names, which may lead to inconsistency in the application of the technique and result in confusion amongst clinicians, software vendors, regulators and the pharmaceutical industry.
- Ensure that the best available scientific evidence is used to support the development of Tall Man names.
- Provide credibility to the technique as a tool that can be used to help reduce the risks associated with look-alike, sound-alike medicine names.

It is envisaged that the standard will be incorporated into medical software in such a way as to enable the presentation of selected (high priority) medicine names in Tall Man format in a variety of settings such as prescribing and dispensing software.

The project has proceeded through a number of stages and which are presented in this report.

Stage 1: Compilation of an Australian list of similar medicines names

Aim

This stage aimed to produce a comprehensive list of similar medicines names relevant to the Australian health care system. Names to be included in the Tall Man standard were subsequently selected from this list.

Method

In order to assemble a comprehensive list of similar medicines names, a variety of information sources was used. A recent piece of work by Emmerton and Rizk[10] at The University of Queensland provided a good review of the literature related to similar medicine names, and produced a list of pairs of medicine names published in the international literature arising from cases of confusion.

The preliminary list was then supplemented with medicine name pairs identified from other information sources, including:

- websites of international medication safety agencies
- warnings and alerts previously issued but not published in the academic literature
- jurisdictional databases of incidents in which medicine name confusion was involved
- the most recent data from Pharmaceutical Defence Limited, the pharmacists' indemnity insurance body who also receive information-related medication incidents, some of which involve medicine name confusion.

Results

A list of 250 pairs of confusable Australian medicine names was compiled. The list comprised 341 discrete names, including 156 generic names and 185 trade names. Several names were similar to more than one other name, and several pharmacological classes of medicine contain a number of agents with similar names.

The compiled list of confusable names is attached (Appendix A).

Limitations

The major limitation of this work is the likelihood of under-reporting of cases of medicine name confusion to health authorities. Indeed, limited data were received from the jurisdictions pertaining to incidents that had been reported through incident monitoring systems. However, it is also possible that these systems contain significant information about risks associated with similar medicine names, but that this information is not readily retrievable.

Newer agents with confusable names may pose a significant risk to patient safety, but may not have been marketed long enough for this risk to have been reported in any of the forums searched.

To address these limitations, a process will be developed to allow ongoing maintenance of this Australian list of confusable medicine names. This process will link directly with the processes for maintaining the Tall Man standard. These processes are further described in Stage 4.

Stage 2: Prioritisation of medicines name pairs and groups for Tall Man application

Purpose

Research by Filik *et al*.[8] indicates that Tall Man lettering may be effective because medicine names presented in this format appear novel and act as a warning. Overuse of the technique may, therefore, reduce its effectiveness as the names no longer appear novel. To ensure that Tall Man lettering has the greatest possible impact, its use should be reserved for those names associated with the *highest risk to patient safety*. These names must be identified through a formal risk assessment process.

These risk assessment processes have been compiled to ensure that the actions taken by the Commission to derive the national standard for Tall Man lettering are transparent, reproducible, and based on the best available evidence.

It must be acknowledged that multiple factors contribute to the confusability of medicine names and to the severity or potential severity of such confusion. These factors have been highlighted in work by Emmerton & Rizk[10] and Lambert et al[11]. As a result, it is recognised that elements of the risk assessment process will be subjective and will rely on the input of a panel of expert clinicians.

Aim

The aim of the risk assessment process was to reduce the compiled list of potentially confusable medicine names relevant in the Australian health care environment to a succinct list of those names that are most likely to cause patient harm due to their confusability.

Pairs and groups of medicine names were identified by a risk matrix based on:

- The **likelihood** that the names would be confused
- The **potential severity** (consequence) of this confusion.

Likelihood of confusion

The confusability of two medicine products is related to a number of factors, including similar:

- appearance of the medicine names (orthography)
- sound of the medicine names (phonology)
- strengths of the products available
- routes of administration or forms of the products available
- indications for use.

As Tall Man lettering is primarily a tool designed to differentiate orthographically similar names, a significant weight should be placed on the degree of orthographic similarity of confusable names.

Taking findings from the fields of cognitive psychology, linguistics and computer science, researchers have developed measures that can be used to quantify the orthographic similarity of two medicine names.[12-14] Kondrak and Dorr[12] evaluated the effectiveness of a range of the measures and found that a measure known as BI-SIM was the single measure of similarity that gave the greatest accuracy when predicting medicine name confusion. Among other features, this measure places emphasis of scoring on similarity found at the *beginning* of the medicine names. This is an important consideration given that the risk of confusing two names will be increased if they appear in close proximity in a list (e.g. on a computer/device screen) or if products are stored alphabetically in close proximity. BI-SIM scores can range from 0.00-1.00.

Lambert et al.[11] highlighted the important effects that other features, such as product strength, dosage form and route of administration can have on the confusability of two medicine products. Of these, *strength* is the feature most commonly associated with the medicine name on prescriptions, on medicine packaging and in computer systems, and should be given greater weighting than similarities in dosage form and/or route of administration.

There is no available literature that quantifies the contribution of these various factors to confusion between medicine names. As such, it was necessary to assign an arbitrary weighting based on the information most likely to be seen and used when reading and selecting medicine products from prescriptions, computer/device screens, and medicine and shelf labels.

For the purposes of this risk assessment, confusability was arbitrarily calculated as a score out of 100. This score is a composite of the following characteristics and weightings:

- Name similarity as calculated using BI-SIM (70%)
- Strength similarity (20%)
- Route similarity (5%)
- Dose form similarity (5%).

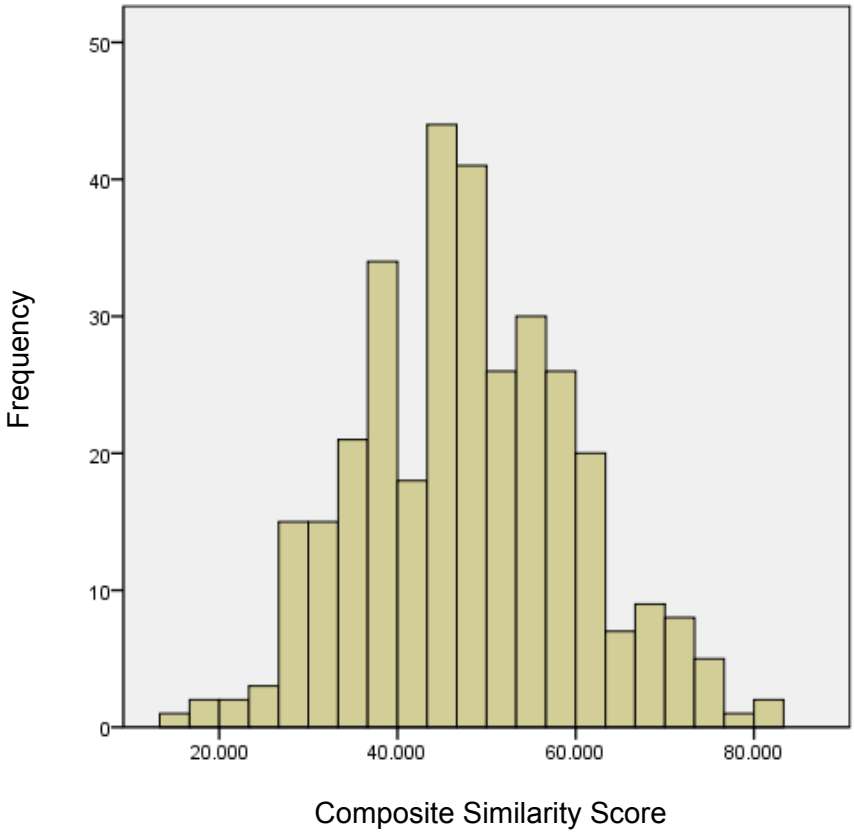
Figure 1: Composition of the similarity score

Name similarity	BI-SIM score x 70
Strength similarity	
No common strength:	0
Some (but not all) strengths in common:	10
All strengths in common:	20
Route similarity	
No common administration route:	0
Some (but not all) routes in common:	2.5
All routes in common	5
Dose form similarity	
No common dose forms:	0
Some (but not all) dose forms in common:	2.5
All dose forms in common:	5
	Max 100

All identified pairs were scored for similarity based upon the features described above. BI-SIM scores were calculated using an online calculator designed by Kondrak.[15] Other product features were taken from the product information provided by the manufacturers, and all products were included where multiple brands and forms were available for a generic medicine with a confusable name.

Calculated similarity scores ranged from 15.0 to 82.5, with a mean of 48.1 and a standard deviation of 12.1. The distribution of scores was determined to be normal using the Kolmogorov-Smirnov test (p=0.724), as illustrated in Figure 2 (full details of statistics available on request).

Figure 2: Distribution of composite similarity scores



Similarity scores were divided into five groups with divisions made at the 20th, 40th, 60th and 80th percentiles. Name pairs were allocated into one of five categories (with 1 being the most similar and 5 being the least similar) denoting the likelihood of confusion. This categorisation allowed for the use of a risk matrix to estimate overall risk associated with the name pair (see below).

Potential severity

The 'severity' or 'potential consequence' of confusion between two medicine products is difficult to predict, as factors such as the duration of exposure to the 'wrong' medicine and the patient's co-morbidities, other medicines and overall wellbeing will impact significantly on the outcome.

The severity index solely considered the clinical properties of the two (or more) medicines that are at risk of confusion. The index was determined using the following assumptions:

- That the exposure to the 'wrong' medicine was short term (i.e. that the error was detected within one week)
- That the patient was otherwise healthy.

Confusion between two medicine names can occur in either of two directions (i.e. medicine A intended but B given, or medicine B intended and A given). For this risk assessment, severity was assigned based on whichever direction had the greater potential severity.

Whilst every medication error has the potential to cause harm in certain circumstances, this risk assessment aimed to assign realistic severity scores.

The potential severity rating took into consideration factors such as:

- Whether either (or any) of the medicines involved is a known 'high risk' medicine, such as:
    - Concentrated electrolytes
    - Insulin
    - Anticoagulants
    - Opioids
    - Cytotoxics
- The number of doses that would need to be administered to cause harm
- Whether allergy to either medication is common
- Whether either medication has a significant number of known significant medicine interactions (greater than five major interactions per Micromedex®
- Whether either medication has a narrow therapeutic index
- Whether administration of the intended medication is time-critical
- How long the patient could proceed without the intended treatment before being adversely affected.

Name pairs were assigned a severity of 'serious', 'major', 'moderate', 'minor' or 'minimum' through a process of expert review, described below. These categories were defined as:

Catastrophic	Confusion between the two medicines is likely to (or has been documented to) result in patient death or would require an intervention to sustain life.
Major	Confusion between the two medicines is likely to (or has been documented to) cause significant injury such as loss of organ function, or would require an intervention to prevent significant injury.
Moderate	Confusion between the two medicines is likely to (or has been documented to) require hospitalisation or transfer to a higher level of care (e.g. transfer to ICU).

Minor	Confusion between the two medicines is likely to (or has been documented to) require increased observations or monitoring to ensure that it does not have an adverse outcome.
Minimum	Confusion between the two medicines is unlikely to cause any adverse outcome.

Expert review

As the potential severity is a subjective measure, severity categorisation was conducted by a panel of experts. The panel of experts comprised 31 clinicians, who were clinical pharmacists with varying roles (n=26), clinical pharmacologists (n=2), safety officers with nursing backgrounds (n=2) and a nurse unit manager. All members of the expert panel were provided with instructions for completing the risk assessment (Appendix B Part A and Part B).

The expert review was conducted in two phases. In the first, 20 randomly selected name pairs were reviewed by all members of the expert panel to test the consistency of their ratings. All 31 reviewers rated all 20 pairs for severity. Intraclass correlation was calculated using SPSS and showed strong inter-rater reliability ($\alpha = 0.961$, 95% confidence interval 0.931 – 0.982, $p<0.001$).

To rate the remaining name pairs, expert reviewers were divided into groups of three and randomly allocated 23 name pairs to assess. The assessment was completed online and independently, except in the case of two groups (six assessors), who met and discussed their evaluation, reaching consensus on the severity before submitting their results. In total, 28 reviewers completed this stage of the severity rating, with a minimum of three clinicians rating each item.

Where there was not unanimous agreement between expert reviewers as to the risk associated with a name pair, severity was allocated based on the view of the majority (where two reviewers agreed) or the average score given. Two or more panel members agreed on severity for over 85% of items rated.

Risk rating

Using the scores calculated for likelihood and severity of confusion, the following risk matrix (Figure 3) was used to categorise the overall risk associated with the medicine name pair.[16-17]

Figure 3: Risk matrix

		Potential Severity				
		Minimum	Minor	Moderate	Major	Catastrophic
Likelihood of Confusion	1	**M**	**H**	**E**	**E**	**E**
	2	**M**	**H**	**H**	**E**	**E**
	3	**L**	**M**	**H**	**H**	**E**
	4	**L**	**M**	**M**	**H**	**H**
	5	**L**	**L**	**L**	**M**	**M**

E – Extreme risk | H – High risk | M – Moderate risk | L- Low risk

This risk matrix was derived using principles outlined by the National Patient Safety Agency in the UK[17] and the National Coordinating Council for Medication Error Reporting and Prevention in the USA[16].

Severity scores were assigned based on pairs of medicines names, not groups as a whole. All combinations identified as potentially confusable were risk assessed.

Those medicine name pairs that are deemed to be of extreme or high risk (in the matrix, falling into the red or orange cells, respectively) were then sorted for the application of Tall Man lettering.

A decision to *not* include a pair of similar medicine names in the Tall Man standard does not imply an acceptance of the risk associated with their name similarity. Other methods for reducing risk, such as use of bar code scanners, addressing storage conditions etc. should be employed to minimise these risks.

Risk ratings, together with composite similarity score and potential severity of confusion for each name pair are presented in Appendix C.

Limitations

This type of process has inherent limitations. The major limitation is that the risk matrix is only two dimensional, applying the 'likelihood of confusion' and 'potential severity of confusion'. Additional factors such as the likelihood that the error would be detected and the frequency with which the error is likely to occur would enhance the risk assessment. However, these variables are highly practice specific and not easily measured. Whilst their inclusion in the assessment would be ideal from a risk-management perspective, it is not crucial for an effective risk assessment in this context and given that the task at hand is to prioritise medicines inclusion in a Tall Man standard.

The severity scoring used in the risk assessment process is, by necessity, a subjective measure. Under certain circumstances, omission or inadvertent administration of almost any medication can have extreme consequences. Predicting which error is likely to cause harm most often is, therefore, difficult and reliant on a number of variables that could not be controlled for in this process. These include a large range of patient specific factors such as co-morbidities, previous allergies/adverse drug reactions and other medication taken concurrently. However, based on clinicians' experience and judgement, meaningful severity scores have been allocated.

Stage 3: Formulating Tall Man names

This stage derived the Tall Man format for the highest priority medicine pair names that were identified above.

Various permutations of Tall Man typography have been represented in the literature. The common element is the attempt to highlight the differences between the two names. Van de Vreede et al.[18] outlined the following as a set of principles for their application of Tall Man typography:

- Highlight three to five letters that are different;

- Choose, if possible, letters that formed a syllable; and
- Highlight letters closest to the beginning of the word that are different, to facilitate correct selection when electronic drop-down menus are used.

Recent studies conducted for the National Health System (UK) *Connecting for Health* program have evaluated the effectiveness of Tall Man names constructed by various methods, and concluded that a method dubbed Mid Tall Man lettering was the most effective and most easily applied in a systematic fashion[19].

This method works by the following rules (taken from[19]):

Methodology for producing Mid-type Tall Man medicine names
The Mid 'rule' was created by taking two or more look-alike, sound-alike medicine names and

Step one
Working from the first letter of the medicine name take each common character to the right until two or more characters are different, and from that point on capitalise the characters.

Thus:	**Become:**
cefuroxime	cefUROXIME
cefotaxime	cefOTAXIME
ceftazidime	cefTAZIDIME

Step two
Working from the last letter of the word, take each capitalised common character to the left until two or more characters are different, and change the capital letters to that point back to lowercase.

Thus:	**Become:**
cefUROXIME	cefUROXime
cefOTAXIME	cefOTAXime
cefTAZIDIME	cefTAZIDime

Use of this rule has been supported through stakeholder consultation and has been applied in this national standard. For some larger groups of confusable medicines names, such as the cephalosporins for instance, application of the Mid rule may be problematic.

For the application of Tall Man lettering, names were grouped as appropriate. For example, the confusable name pairs aldomet and aldactone and aldomet and alodorm were grouped before the application of Tall Man lettering. Where there was no natural grouping, or where no natural grouping seemed logical, Tall Man lettering was applied first to the name pair (or natural grouping) that carried the highest risk, and then subsequent pairs.

In this way, the main risks of confusion have been addressed more satisfactorily than through rigid application of the Mid rule.

Figure 4: Example of the application of Tall Man lettering to a group

Three name pairs – doxorubin / daunorubicin, doxorubicin / idarubicin and daunorubicin / idarubicin were all identified as having high or extreme risk ratings.

As these three names all share common orthographic elements, they were treated as a group for the construction of Mid Tall Man names.

Stage one

doxorubicin	DOXORUBICIN
daunorubicin	DAUNORUBICIN
Idarubicin	IDARUBICIN

Stage two

DOXORUBICIN	**DOXO**rubicin
DAUNORUBICIN	**DAUNO**rubicin
IDARUBICIN	**IDA**rubicin

In contrast, the three names carbamazepine, oxcarbazepine and carbimazole form a different type of group. Whilst there are some similarities between carbimazole and oxcarbazepine, this is not a recognised look-alike, sound-alike pair, nor is there a great orthographic similarity between the two names. Carbamazepine shares significant similarities with both these names. If the standard Mid formula were applied to all three names simultaneously, the following would be the result.

Stage one

carbamazepine	CARBAMAZEPINE
oxcarbazepine	OXCARBAZEPINE
carbimazole	CARBIMAZOLE

Stage two

CARBAMAZEPINE	**CARBAMAZEPIN**e
OXCARBAZEPINE	**OXCARBAZEPIN**e
CARBIMAZOLE	**CARBIMAZOL**e

These names are essentially presented in upper case and there is little to identify the words as being in Tall Man format. Additionally, the differences between names have not been highlighted. In this instance, the name pair with the greater severity was used as the key pair. For these names, carbamazepine and oxcarbazepine were rated as being of extreme risk, while carbimazole and carbamazepine was rated as a high risk.

Tall Man names were then constructed in the following way

Stage one

carbamazepine	CARBAMAZEPINE
oxcarbazepine	OXCARBAZEPINE

Stage two

CARBAMAZEPINE	**CARBAM**azepine
OXCARBAZEPINE	**OXCARB**azepine

The third name, in this instance carbimazole, was constructed as if it were paired against carbamazepine to give carb**IMAZOL**e.

A complete list of the Tall Man names constructed for the standard is attached at Appendix D. A list of names constructed using exceptions to the Mid rule is attached at Appendix E.

Despite being found to be a significant risk to patient safety, some confusable medicine name pairs were excluded from the standard list of Tall Man names. This was mainly due to the fact that the names did not share adequate orthographic similarity to warrant the use of Tall Man. Generally, this was considered to be the case if Tall Man names did not contain at least two lower case letters. An example is the name pair Fungizone and Ambisome. Whilst this pair of medicines has caused considerable confusion, resulting in patient harm, use of Tall Man lettering, especially Mid format Tall Man lettering, is unlikely to considerably reduce the confusability of the two names. For these medicines, confusion likely arises from the fact that the two products are different formulations of the same active ingredient. Other interventions should be made to reduce harm from such confusable products.

Observance of general conventions

Although there are no formal standards governing the presentation of medicines names, there are a number of widely accepted conventions. Commonly, to differentiate between generic and proprietary names, generic medicines names are presented in all lower case while proprietary names are presented as proper nouns i.e. with a capital first letter followed by lower case. This convention is observed in many software programs and has been retained in Tall Man lettering of organisations such as the Institute for Safe Medication Practices[20]. Examples of names in this format include ZyPREXA and ZyrTEC. It is understood that names are presented in this way so as to clearly identify them as being proprietary names.

The purpose of Tall Man lettering is to highlight the differences between similar medicine names using capitalisation. This is especially true of names created using the Mid rule. Where the initial letter of two similar proprietary names is the same, its capitalisation does not highlight differences between the two names. For this reason, this convention has been ignored for the purposes of this standard.

Internationally, Tall Man lettering has generally been applied to generic names. In the Australian context, particular in the community, proprietary names are still commonly used for medicines. As most medicines use occurs in the community setting, a decision has been made to include proprietary names in the standard.

Legal considerations

It is acknowledged that medicines names are protected through laws related to intellectual property. Certain medicines names are presented by the product sponsor in a specific format e.g. OxyContin®. Legal advice was sought in relation to the altering of medicine name presentations through the application of Tall Man lettering. Advice received suggested that trademarks are generally granted to words presented in all upper case, allowing the trademark owner flexibility in how they present the word. These trademarks were not seen as inhibiting the application of Tall Man lettering to proprietary names.

Stage 4: User-testing the Tall Man standard

Ensuring the proposed medicine names with Tall Man lettering applied is not detrimental is critical to its acceptance. The names will be human factors tested using approximately 65 clinicians to record responses to the medicines names with Tall Man lettering applied.

Testing will cover the rates of selection error using three formats; natural case, Mid Tall Man and random capitalisation. The conclusion sought will be that less selection errors occur with Mid Tall Man lettering and that standardised Tall Man is not detrimental.

Testing will occur from March to June 2011 and will be reported separately.

Stage 5: Maintaining the Tall Man standard

To ensure that the standard maintains currency, it is important that the Commission both reactively and proactively assesses the standard.

Reactive Assessment of the Standard

As for other Commission national standardisations, a change request register will be established. The register will enable clinicians (and potentially members of the public) to notify the Commission of medicine name pairs, or groups, that they believe pose a risk to patient safety and that may benefit from the application of Tall Man lettering.

Issues noted on the register will be considered by the national committee which is convened by the Commission to advise it on maintenance of national standardisations. The committee will recommend names that should have the same risk assessment methodology applied to them that were used in construction of the initial standard. If the process establishes that medicine name pairs or groups present a high risk of confusion, and of patient harm if confused, then the Commission will update the national list and notify stakeholders through its usual communication channels.

In addition, the Commission will conduct quarterly scans of the products available on the Australian market to ensure that the standard does not contain products that have been discontinued. A regular publication, such as MIMS monthly, may be used for information regarding discontinuations.

Proactive Assessment of the Standard

The Therapeutic Goods Administration (TGA) has undertaken to test use of software used to calculate medicine name similarity currently in use by the Food and Drug Administration in the United States of America. Pre-marketing assessment of medicines names using this tool will highlight medicines with similar names. Where medicines have similar names detected using this tool, but are still registered under the tested name, these names should be considered for inclusion in the standard.

In principle support for collaboration between the TGA and the Commission in this way has been given. Formalised processes for notification will need to be established one the TGA has completed its testing of the system.

Additions and deletions

One key aim of developing the Tall Man standard has been to keep the total number of names included in the standard low to avoid overuse of the technique. In accordance with this principle, stakeholders endorsed the notion that the total number of names included in the standard should not vary by more than ± 10%. Where additions or deletions are considered necessary, and result in a greater than 10% change, a risk assessment process will be conducted to reprioritise items and adjust the standard as needed.

Consultation

In preparing this work, the following individuals and organisations have been consulted:

Ms Fiona McIver	Safe Medication Management Unit, Medication Services, Queensland Health
Ms Kate Short and Mr Albert Regoli	Pharmaceutical Defence Limited
Dr Lynne Emmerton and Ms Mariam Rizk	School of Pharmacy, The University of Queensland
Mr John Green	Medical Software Industry Association
Mr John Barned	National e-Health Transition Authority
Ms Melita Van de Vreede	Eastern Health, Victoria
Ms Catherine Rokahr	Department of Human Services, Victoria
Ms Kay Sorimachi	Pharmaceutical Society of Australia
Ms Karen O'Leary Ms Natalie Collard	Society of Hospital Pharmacists of Australia
Mr Vincent O'Sullivan Mr Peter Guthrey	Pharmacy Guild of Australia
Ms Elizabeth de Somer	Medicines Australia
Ms Sarah Lam	AstraZeneca
Ms Michelle Sweidan	National Prescribing Service
Mr Pio Ceasarin	Therapeutic Goods Administration
Ms Kate Richardson	St Vincent's Public Hospital, Darlinghurst, NSW
Ms Margaret Duguid Mr Graham Bedford	Australian Commission on Safety and Quality in Health Care

These individuals and organisations have contributed to the development of risk assessment documents and have discussed proposed plans for development of the standard. Teleconferences were held on 13 October 2010 and 3 December 2010. The feedback and input of these individuals and organisations is acknowledged and appreciated.

Appendix 1: A comprehensive list of confusable Australian medicines names

In order to assemble a comprehensive list of similar medicines names, a variety of information sources was used. A recent piece of work by Emmerton and Rizk[10] at The University of Queensland provided a good review of the literature related to similar medicine names, and produced a list of pairs of medicine names published in the international literature arising from cases of confusion.

The preliminary list was then supplemented with medicine name pairs identified from other information sources, including:

- Websites of international medication safety agencies
- Warnings and alerts previously issued but not published in the academic literature
- Jurisdictional databases of incidents in which medicine name confusion was involved
- The most recent data from Pharmaceutical Defence Limited, the pharmacists' indemnity insurance body who also receive information-related medication incidents, some of which involve medicine name confusion.

Results

A list of 250 pairs of confusable Australian medicine names was compiled. The list comprised 341 discrete names, including 156 generic names and 185 trade names. Several names were similar to more than one other name, and several pharmacological classes of medicine contain a number of agents with similar names.

The compiled list of confusable names is below.

Name 1	Name 2
Abelcet (amphotericin B - phospholipid)	Amphotericin B
Actonel (risedronate)	Actos (pioglitazone)
Adalat (nifedipine)	Aldomet (methyldopa)
Aldactone (sprionolactone)	Aldomet (methyldopa)
Alkeran (melphalan)	Leukeran (chlorambucil)
Alkeran (melphalan)	Myleran (bisulfan)
Alphapress (hydralazine)	Alphapril (enalapril)
Alprazolam	Lorazepam
Alprim (trimethoprim)	Solprin (aspirin)
Amantadine	Cimetidine
Amaryl (glimepiride)	Amoxil (amoxycillin)
Amaryl (glimepiride)	Reminyl (galantamine)
Ambisome (amphotericin - liposomal)	Fungizone (amphotericin B)
Amikin (amikacin)	Kineret (anakinra)
Aminophylline	Amiodarone
Amiodarone	Amlodipine
Amitriptyline	Aminophylline

Amlodipine	Amiloride
Amorolfine	Aminophylline
Amoxycillin	Ampicillin
Anzemet (dolasetron)	Aldomet (methyldopa)
Apomine (apomorphine)	Avomine (promethazine)
Aratac (amiodarone)	Aropax (paroxetine)
Aratac (amiodarone)	Arabloc (leflunomide)
Atropt (atropine)	Azopt (brinzolamide)
Aurorix (moclobemide)	Aropax (paroxetine)
Auspril (enalapril)	Auscap (fluoxetine)
Avastin (bevacizumab)	Avaxim (Hepatitis A vaccine)
Azathioprine	Azithromycin
Beclomethasone	Betamethasone
Bimatoprost	Brimonidine
Bisoprolol	Bisacodyl
Bumetanide	Budesonide
Bupropion	Busprione
Capoten (captopril)	Gopten (trandolapril)
Carafate (sucralfate)	Caltrate (calcium carbonate)
Carbamazepine	Oxcarbazepine
Carbimazole	Carbamazepine
Cardizem (diltiazem)	Cardiprin (aspirin)
Carvedilol	Captopril
Cipramil (citalopram)	Ciproxin (ciprofloxacin)
Cisplatin	Carboplatin
Clarithromycin	Ciprofloxacin
Clomipramine	Clomiphene
Clomipramine	Chlorpromazine
clonazepam	Lorazepam
Clonazepam	Clonidine
Colchicine	Cortisone
Cortisone	Cordarone (amiodarone)
Coumadin (warfarin)	Coversyl (perindopril)
Cozaar (losartan)	Zocor (simvastatin)
Cyclosporin	Cycloserine
Dactinomycin	Daptomycin
Daonil (glibenclamide)	Deseril (methysergide)
Daunorubicin	Idarubicin
Depo-Medrol (methylprednisolone)	Solu-Medrol (methylprednisolone)
Depo-Medrol (methylprednisolone)	Depo-Provera (medroxyprogesterone acetate)
Deptran (doxepin)	Deralin (propranolol)
Deptran (doxepin)	Ditropan (oxybutynin)
Deptran (doxepin)	Endep (amitriptyline)
Diaformin (metformin)	Diamicron (gliclazide)
Diazepam	Lorazepam

Dicloxacillin	Flucloxacillin
Didronel (disodium etidronate)	Didrocal (calcium disodium etidronate)
Difflam (benzydamine hydrochloride)	Differin (adapalene)
Diflucan (fluconazole)	Diprivan (propofol)
Dilaudid (hydromorphone)	Dilantin (phenytoin)
Dimirel (glimepiride)	Reminyl (galantamine)
Diovan (valsartan)	Zyban (bupropion)
Diprivan (propofol)	Ditropan (oxybutynin)
Dipyridamole	Disopyramide
Dithiazide (hydrochlorthiazide)	Ditropan (oxybutynin)
Dobutamine	Dopamine
Docetaxel	Paclitaxel
Dothiepin	Doxepin
Doxorubicin	Idarubicin
Duloxetine	Fluoxetine
Famotidine	Felodipine
Flucloxacillin	Fluconazole
Fluoxetine	Paroxetine
Fluoxetine	Fluvoxamine
Gemfibrozil	Gabapentin
Glibenclamide	Glipizide
Glibenclamide	Gliclazide
Glibenclamide	Glimepiride
Gliclazide	Glipizide
Gliclazide	Glimepiride
Glipizide	Glimepiride
Hydrea (hydroxyurea)	Hydrene (hydrochlorothiazide - triamterene)
Ifosfamide	Cyclophosphamide
Imdur (isosorbide mononitrate)	Imuran (azathioprine)
Imdur (isosorbide mononitrate)	Ibilex (cephalexin)
Imipramine	Clomipramine
Imipramine	Trimipramine
Infliximab	Rituximab
Inspra (eplenerone)	Spiriva (tiotropium)
Isordil (isosorbide mononitrate)	Plendil (felodipine)
Isotretinoin	Tretinoin
Janumet (metformin/sitagliptin)	Januvia (sitagliptin)
Kalma (alprazolam)	Kaluril (amiloride hydrochloride)
Keflex (cephalexin)	Keppra (levetiracetam)
Ketotifen	Ketoprofen
Lamictal (lamotrigine)	Largactil (terbinafine)
Lamictal (lamotrigine)	Lamisil (chlorpromazine)
Lamivudine	Lamotrigine
Lasix (frusemide)	Losec (omeprazole)
Lasix (frusemide)	Lescol (fluvastatin)

Lasix (frusemide)	Luvox (fluvoxamine)
Leucovorin (calcium folinate)	Leukeran (chlorambucil)
Levlen (ethinyleostradiol - levonorgestrel)	Logynon (ethinyleostradiol - levonorgestrel)
Lipex (simvastatin)	Lipitor(atorvastatin)
Lipidil (fenofibrate)	Lipazil (gemfibrozil)
Lipitor (atorvastatin)	Loniten (minoxidil)
Lipitor (atorvastatin)	Zyrtec (cetirizine)
Loratadine	Lorazepam
Losec (omeprazole)	Prozac (fluoxetine)
Lovan (fluoxetine)	Luvox (fluvoxamine)
Maxolon (metoclopramide)	Moxacin (amoxycillin)
Melphalan	Thyroxine
Meningitec (Neisseria meningitidis vaccine)	Mencevax (Neisseria meningitidis vaccine)
Metformin	Metronidazole
Methadone	Methylphenidate
Mifepristone (RU486)	Misoprostol
Mirtazapine	Nitrazepam
Mobilis (prioxicam)	Movalis (meloxicam)
Mogadon (nitrazepam)	Maxolon (metoclopramide)
Monoplus (fosinopril - hydochlorthiazide)	Mobilis (piroxicam)
Monopril (fosinopril)	Monoplus (fosinopril - hydochlorthiazide)
Morphine	Hydromorphone
MS Contin (morphine)	OxyContin (oxycodone)
Neurontin (gabapentin)	Noroxin (norfloxacin)
Nimodipine	Nifedipine
Nizatidine	Nifedipine
Norfloxacin	Ciprofloxacin
Norimin (ethinyleostradiol - norethisterone)	Norinyl (norethisterone - mestranol)
Norvasc (amlodipine)	Normison (temazepam)
Novomix (insulin aspart (rys) - combination rapid and intermediate acting)	Novorapid (insulin aspart (rys) - rapid acting)
Olanzapine	Quetiapine
Oxycodone	OxyContin (oxycodone)
Oxycodone	Oxybutynin
Panadeine Forte (paracetamol - codeine)	Prednefrin Forte (phenylephrine hydrochloride - prednisolone acetate)
Panafcort (prednisone)	Panafcortelone (prednisolone)
Paxam (clonazepam)	Paxtine (paroxetine)
Pethidine	Prothiaden (dothiepin)
Pramin (metoclopramide)	Pressin (prazosin)
Prazosin	Pravastatin
Prednisolone	Prednisone

Prednisolone	Primidone
Primacor (milrinone)	Primaxin (cilastatin-imipenem)
Primaxin (cilastatin-imipenem)	Primacin (primaquine)
Prograf (tacrolimus)	Prozac (fluoxetine)
Promethazine	Prochlorperazine
Propranolol	Propofol
Proven (ibuprofen)	Paroven (hydroxyethylrutosides)
Reminyl (galantamine)	Robinul (glycopyrolate)
Rifampicin	Rifabutin
Risperidone	Ropinirole
Rocaltrol (calcitriol)	Roaccutane (isotretinoin)
Saquinavir	Sinequan (doxepin)
Seretide (fluticasone/salmeterol)	Serevent (salmeterol)
Seroquel (quetiapine)	Sinequan (doxepin)
Sinequan (doxepin)	Singulair (montelukast)
Solu-Cortef (hydrocortisone)	Solu-Medrol(methylprednisolone)
Sotalol	Sudafed (phenylephrine)
Sulfasalazine	Mesalazine
Sumatriptan	Zolmitriptan
Sunitinib	Sorafenib
Suxamethonium	Pancuronium
Tegretol (carbamazepine)	Trental (oxpentifylline)
Tenopt (timolol maleate)	Cosopt (dorzolamide hydrochloride - timolol maleate)
Ticarcillin	Tacrolimus
Topamax (topirimate)	Toprol-XL (metoprolol)
Trimipramine	Trimeprazine
Valaciclovir	Valganciclovir
Valcyte (valganciclovir)	Valtrex (valaciclovir)
Vasocardol (diltiazem)	Veracaps (verapamil)
Vinblastine	Vincristine
Xalatan (latanoprost)	Xalacom (latanoprost - timolol maleate)
Xanax (alprazolam)	Zantac (ranitidine)
Xeloda (capecitabine)	Xenical (orlistat)
Zantac (ranitidine)	Zyrtec (cetirizine)
Zestril (lisinopril)	Zyrtec (cetirizine)
Zinvit (zinc - vitamin C)	Zinnat (cefuroxime)
Zocor (simvastatin)	Zoton (lansoprazole)
Zocor (simvastatin)	Zestril (lisinopril)
Zocor (simvastatin)	Zyrtec (cetirizine)
Zofran (ondansetron)	Zoton (lansoprazole)
Zoloft (sertraline)	Zocor (simvastatin)
Zolpidem	Zopiclone
Zolpidem	Zolmitriptan
Zostrix (capsaicin)	Zovirax (aciclovir)

Zovirax (aciclovir)	Zyvox (linezolid)
Zyprexa (olanzapine)	Zyrtec (cetirizine)
Akamin (minocycline)	Aclin (sulindac)
Aldomet (methyldopa)	Alodorm (nitrazepam)
Arthrexin (indomethacin)	Aurorix (moclobemide)
Avandia (rosiglitazone)	Avanza (mirtazepine)
Carboplatin	Cisplatin
Ceftazidime	Cephazolin
Daunorubicin	Doxorubicin
Humalog	Humulin
Kaletra (lopinavir - ritonavir)	Keppra (levetiracetam)
Ketalar (ketamine)	Ketorolac
Lantus (insulin glargine)	Lanvis (thioguanine)
Leukeran (chlorambucil)	Myleran (busulfan)
Nexavar (sorafenib)	Nexium (esomeprazole)
Nizatidine	Nimodipine
Oxazepam	Diazepam
Prednisolone	Risperidone
Salbutamol	Salmeterol
Sitagliptin	Sumatriptan
Sulfasalazine	Sulfadiazine
Taxol	Taxotere
Zestril (lisinopril)	Zyprexa (olanzapine)

Cephalosporins
Cefaclor
Cephalexin
Cephalothin
Ceftriaxone
Cephazolin
Cefoxitin
Cefepime
Cefotaxime
Ceftazidime

Appendix B: Part A: Risk assessment processes

Purpose

Research by Filik *et al*.(8) indicates that Tall Man lettering may be effective because medicine names presented in this format appear novel and act as a warning. Overuse of the technique may, therefore, reduce its effectiveness as the names no longer appear novel. To ensure that Tall Man lettering has the greatest possible impact, its use should be reserved for those names that are at significant risk of confusion and when confused have the potential to cause patient harm.

This document will outline the risk assessment processes to be used in selecting confusable medicine names for inclusion in the Tall Man standard. These risk assessment processes have been compiled to ensure that the actions taken by the Commission to derive the national standard for Tall Man lettering are transparent, reproducible, and based on the best available evidence.

It must be acknowledged that multiple factors contribute to the confusability of medicine names and to the severity or potential severity of such confusion. As a result, it is necessary that some proportion of the overall risk assessment process will be subjective and will rely on the input of a panel of expert clinicians.

Risk assessment

Aim

The aim of the risk assessment process is to reduce the compiled list of potentially confusable medicine names relevant in the Australian health care environment to a succinct list of those names that are most likely to cause patient harm due to their confusability. This final list will contain approximately 40 pairs/groups of confusable generic names, 40 pairs/groups of confusable brand names and a group of 10 confusable names specific to oncology practice.

Pairs / groups of medicine names will be identified by a risk matrix based on:

- The **likelihood** that the names will be confused, and
- The **potential severity** (consequence) of this confusion.

Likelihood of confusion

The confusability of two medicine products is related to a number of factors including similar:

- appearance of the medicine names (orthography);
- sound of the medicine names (phonology);
- strengths of the products available;
- routes of administration or forms of the products available; and
- indications for use.

As Tall Man lettering is primarily a tool designed to differentiate orthographically similar names, a significant weight should be placed on the degree of orthographic similarity of confusable names.

Taking findings from the fields of cognitive psychology, linguistics and computer science, researchers have developed measures that can be used to quantify the orthographic similarity of two medicine names(10-12). Kondrak and Dorr(10) evaluated the effectiveness of a range of the measures and found that a measure known as BI-SIM was the single measure of similarity that gave the greatest accuracy when predicting medicine name confusion. Among other features, this measure places emphasis of scoring on similarity found at the beginning of the medicine names. This is an important consideration given that the risk of confusing two names will be increased if they appear together on a computer / device screen or if products will be stored in close proximity. BI-SIM scores can range from 0.00-1.00.

Lambert et al.(13) highlight the important effect that other features, such as product strength, form and route of administration can have on the confusability of two medicine products. Of these, strength is the feature most commonly associated with the medicine name on prescriptions, on medicine packaging, and in computer systems.

Route and form are other features that may be used to verify the identity of a medicine name, or that may contribute to confusion between two products.

There has been no definitive study that has quantified the contribution of these various factors to confusion between medicine names. As such, it is necessary to assign an arbitrary weighting based on what information is most likely to be seen and used when reading and selecting medicine products from prescriptions, computer / device screens, and medicine and shelf labels.

For the purposes of this risk assessment, confusability is arbitrarily calculated as a score out of 100. This score is a composite score of name similarity as calculated using BI-SIM (70%), strength similarity (20%), route similarity (5%) and dose form similarity (5%).

Name similarity	BI-SIM score x 70
Strength similarity	
No common strength:	0
Some (but not all) strengths in common:	10
All strengths in common:	20
Route similarity	
No common administration route:	0
Some (but not all) routes in common:	2.5
All routes in common	5
Dose form similarity	
No common dose forms:	0
Some (but not all) dose forms in common:	2.5
All dose forms in common:	5
	———
	Max 100

Once all identified pairs have been scored, distribution of scores will be measured and items allocated into one of five categories (with 1 being the most similar and 5 being the least similar) denoting the likelihood of confusion.

Potential severity

The severity or potential consequence of confusion between two medicine products is difficult to predict, as factors such as the duration of exposure to the 'wrong' medicine and the patient's co-morbidities, other medicines and overall wellbeing will impact significantly on the outcome. The severity score used for this risk assessment assumes short-term exposure to the 'wrong' medicine, and an otherwise healthy patient.

The severity index solely considers the properties of the two (or more) medicines that are at risk of confusion.

Confusion between two medicine names could occur in either of two directions (i.e. medicine A intended but B given, or medicine B intended and A given). For this risk assessment, severity will be assigned based on whichever direction has the greater potential severity.

Whilst every medication error has the potential to cause harm in certain circumstances, this risk assessment will aim to assign realistic severity scores.

The potential severity rating will take into consideration factors such as:

- Whether either (or any) of the medicines involved is a known 'high risk' medicine, such as:
  - concentrated electrolytes
  - insulin
  - anticoagulants
  - opioids
  - cytotoxics
- The number of doses that would need to be administered to cause harm
- Whether allergy to either medication is common
- Whether either medication has a significant number of known significant medicine interactions (greater than 5 major interactions per micromedex)
- Whether either medication has a narrow therapeutic index
- Whether administration of the intended medication is time-critical?
- How long the patient could go without the intended treatment before being adversely affected.

The name pair will then be assigned a severity of serious, major, moderate, minor or minimum through a process of expert review. These categories are defined as:

Catastrophic	Confusion between the two medicines is likely to (or has been documented to) result in patient death or would require an intervention to sustain life.
Major	Confusion between the two medicines is likely to (or has been documented to) cause significant injury such as loss of organ function, or would require an intervention to prevent

	significant injury.
Moderate	Confusion between the two medicines is likely to (or has been documented to) require hospitalisation or transfer to a higher level of care (e.g. transfer to ICU).
Minor	Confusion between the two medicines is likely to (or has been documented to) require increased observations or monitoring to ensure that it does not have an adverse outcome.
Minimum	Confusion between the two medicines is unlikely to cause any adverse outcome.

Expert review

As the potential severity is a subjective measure, severity categorisation will be conducted by a panel of experts. This panel of experts will be comprised of pharmacists, nurses and doctors (subject to availability).

The compiled list of 254 similar medicine name pairs will be randomly distributed to pairs of panel members for severity assessment. Prior to this, a randomly selected core set of similar pairs will be sent to all panel members to provide a measure of inter-rater reliability.

Where medicine name pairs are given different ratings by different panel members, a third reviewer will be used to solve the discrepancy.

Risk rating

Once the likelihood of confusion and the potential severity have been scored, the following risk matrix will be used to categorise the overall risk associated with the name pair (14,15,16).

		Potential Severity				
		Minimum	Minor	Moderate	Major	Catastrophic
Likelihood of Confusion	1	**M**	**H**	**E**	**E**	**E**
	2	**M**	**H**	**H**	**E**	**E**
	3	**L**	**M**	**H**	**H**	**E**
	4	**L**	**M**	**M**	**H**	**H**
	5	**L**	**L**	**L**	**M**	**M**

E – Extreme risk | H – High risk | M – Moderate risk | L- Low risk

Those name pairs (groups) that are deemed to be of extreme or high risk will be included in the standard. Those items of moderate risk with high likelihood of confusion will be considered for inclusion in the standard depending on the number of items falling in the extreme and high risk categories.

A decision to not include the names in the Tall Man standard does not imply an acceptance of the risk associated with the name similarity. Other methods of

reducing risk, such as use of bar code scanners, addressing storage conditions etc. should be employed to minimise these risks.

Limitations

This type of process has inherent limitations. The major limitation is that the risk matrix is only two dimensional, applying the likelihood of confusion and potential severity of confusion. Additional factors such as the likelihood that the error would be detected and the frequency with which the error is likely to occur would enhance the risk assessment. However, these variables are highly practice specific and not easily measured, , and whilst their inclusion in the assessment would be ideal from a risk-management perspective, it is not crucial for an effective risk assessment in this context and given that the task at hand is to prioritise medicines for trial application of a Tall Man lettering convention.

The severity scoring used in the risk assessment process is, by necessity, a subjective measure. Under the right circumstances, omission or inadvertent administration of almost any medication can have extreme consequences. Predicting which error is likely to cause harm most often is, therefore, difficult and reliant on a number of variables that could not be controlled for in this process. These include a large range of patient specific factors such as co-morbidities, previous allergies / adverse drug reactions and other medication taken concurrently.

References

1. Phatak HM, Cady PS, Heyneman CA, Culbertson VL. Retrospective Detection of Potential Medication Errors Involving Drugs with Similar Names. Journal of the American Pharmacists Association. 2005;45:616-24.
2. Hoffman JM, Proulx SM. Medication Errors Caused by Confusion of Drug Names. Drug Safety. 2003;26(7):445-52.
3. Pharmaceutical Defence Limited. Ninety-Sixth Annual Report and Statement of Accounts for the year ended 30 June 2008. Hawthorn, Victoria; 2008.
4. Davis NM, Cohen MR, Teplitsky B. Look-alike and sound-alike drug names: the problem and the solution. Hospital Pharmacy. 1992;27(2):95-8, 102-5, 8-10.
5. Institute for Safe Medication Practices. ISMP's List of Confused Drug Names. 2010 [cited October, 2010]; Available from: http://www.ismp.org/Tools/confuseddrugnames.pdf
6. United States Pharmacopeia. Use Caution - Avoid Confusion. USP Quality Review; 2001.
7. FIlik R, Purdy K, Gale A, Gerrett D. Drug name confusion: evaluating the effectiveness of capital ("Tall Man") letters using eye movement data. Social Science and Medicine. 2004;59:2597-601.
8. FIlik R, Purdy K, Gale A, Gerrett D. Labeling of Medicines and Patient Safety: Evaluating Methods of Reducing Drug Name Confusion. Human Factors. 2006;48(1):39-47.
9. Gabriele S. The Role of Typography in Differentiating Look-Alike/Sound-Alike Drug Names. Healthcare Quarterly. 2006;9(Special Issue):88-95.
10. Kondrak G, Dorr B. Automatic identification of confusable drug names. Artificial Intelligence in Medicine. 2006;36:29-42.
11. Lambert B, Donderi D, Senders J. Similarity of Drug Names: Comparison of Objective and Subjective Measures. Psychology and Marketing. 2002 July/August 2002;19(7-8):641-61.
12. Lambert BL. Predicting look- and sound-alike medication errors. American Journal of Health-System Pharmacy. 1997;54:1161–71.
13. Lambert B, Yu C, Thirumalai M. A system for multiattribute drug product comparison. Journal of Medical Systems. 2004;28(1):31-56.
14. National Coordinating Council for Medication Error Reporting and Prevention. NCC MERP Index for Categorizing Medication Errors. 2001. http://www.nccmerp.org/pdf/indexBW2001-06-12.pdf (accessed 4/11/2010).
15. National Patient Safety Agency. A risk matrix for managers. 2008. http://www.nrls.npsa.nhs.uk/resources/?EntryId45=59833 (accessed 4/11/2010).
16. NSW Health. Severity Assessment Code. Internal Document. November 2005.

Appendix B: Part B: Severity assessment assessor instructions

1. Purpose

A list of approximately 250 pairs of confusable medicine names relevant in the Australian context has been compiled. This risk assessment is being undertaken to assist in identifying those confusable names that pose the greatest risk to patient safety. These names will subsequently be included in the Tall Man lettering standard.

The risk assessment process will contain two components: an assessment of the **likelihood of confusion** between two products and an assessment of the **severity or consequence** of this confusion.

Your involvement will be in assessing the potential clinical severity of confusion between various medicines.

2. Severity

Please use your clinical knowledge and experience to assign each pair of similar names a severity rating of:

- Catastrophic;
- Major;
- Moderate;
- Minor; or
- Minimum.

Where the categories are defined as follows:

Catastrophic	Confusion between the two medicines is likely to (or has been documented to) result in patient death or would require an intervention to sustain life.
Major	Confusion between the two medicines is likely to (or has been documented to) cause significant injury such as loss of organ function, or would require an intervention to prevent significant injury.
Moderate	Confusion between the two medicines is likely to (or has been documented to) require hospitalisation or transfer to a higher level of care (e.g. transfer to ICU).
Minor	Confusion between the two medicines is likely to (or has been documented to) require increased observations or monitoring to ensure that it does not have an adverse outcome.
Minimum	Confusion between the two medicines is unlikely to cause any adverse outcome.

3. Considerations

When assessing the potential severity of confusion between the two medicines, the following features of the medicines should be taken into consideration:

- Whether either (or any) of the medicines involved is a known 'high risk' medicine
  - concentrated electrolytes
  - insulin
  - anticoagulants
  - opioids
  - cytotoxics
- The number of doses that would need to be administered to cause harm
- Whether allergy to either medication is common
- Whether either medication has a significant number of known significant medicine interactions (greater than 5 major interactions per micromedex)
- Whether either medication has a narrow therapeutic index
- Whether administration of the intended medication is time-critical?
- How long the patient could go without the intended treatment before being adversely affected.

4. Assumptions

For the purposes of this exercise, please assign 'severity' assuming the following:

- That an error **has** been made, substituting one medication for the other and that this error has reached the patient.
- That an error could have been made during prescribing, dispensing or administration processes (and still reached the patient).
- Confusion between two medicines represents two possible errors (A is intended and B is given, or B is intended and A is given). Where one error is potentially more serious than the other, rate the 'severity' based on the more serious error.
- That the patient is of average health.
- That there is only short-term exposure to the wrong medication, i.e. that the substitution error was detected within one week.

5. Examples of severity assessment

The following examples are provided to give an indication of the range of factors that should be considered when assigning severity ratings.

Assessors do not need to provide their reasoning, unless it is specifically requested.

Example One

Name pair = *cephalexin* and *cefaclor* – **minimum severity**

Reasoning

Neither medication is a high-risk medicine. Allergies are known, but allergy to one is likely to imply allergy to the other (class level).

Both agents have similar spectrums of antimicrobial activity and are commonly used for the same indications.

Neither omission nor commission (assuming treatment is provided with the alternate agent) is likely to cause an adverse outcome.

Example Two

Name pair = *Avandia* (rosiglitazone) and *Avanza* (mirtazepine) – **minor severity**

Reasoning

Neither medication is a high-risk medicine.

Avandia has known serious side effects, including increased risk of myocardial infarction, but this is rare. Allergies are not common, but interactions with both medicines are possible and may lead to hypoglycaemia (if patient is treated with sulphonylurea and receives avandia) or serotonin syndrome (if the patient is already on a SSRI). These are possible outcomes, but not likely.

Drowsiness or altered mental state caused by commission of Avanza would likely result and may need monitoring.

Omission of Avanza (thus abrupt withdrawal) may lead to clinical signs and symptoms of withdrawal, requiring treatment but not likely hospitalisation. Omission of Avandia may affect glycaemic control, requiring increased monitoring.

Example Three

Name pair = *Lamictal* (lamotrigine) and *Largactil* (chlorpromazine) – **moderate severity**

Reasoning

Neither direction of substitution is obviously more severe than the other.

Commission of either medicine is not likely to cause severe and immediate harm – neither is a high risk medicine with serious, common side effects, and allergies or interactions are not common.

Drowsiness caused by commission of Largactil is likely to be the greatest consequence of commission.

Omission of either medicine may cause significant issues either by resulting in a deterioration of mental status or seizure. It is probable that this would result in hospitalisation or increased care requirements and hence a severity rating of moderate.

Example Four

Name pair = *Prograf* (tacrolimus) and *Prozac* (fluoxetine) – **major severity**

Reasoning

Tacrolimus is an immunosuppressant used to prevent rejection of transplanted tissue. Inadvertent administration of tacrolimus may cause immunosuppression and expose the patient to infection. Potentially more seriously, omission of tacrolimus may result in rejection of transplanted tissue or organs.

Example Five

Name pair = *morphine* and *hydromorphone* – **serious severity**

Reasoning

Both morphine and hydromorphone are high risk medicines.

Hydromorphone is a high potency opioid, and there have been a number of cases of serious patient harm, including death, resulting from inadvertent administration of hydromorphone when morphine was intended.

Appendix C: Similar names severity risk score

Aim

The aim of the risk assessment process was to reduce the compiled list of potentially confusable medicine names relevant in the Australian health care environment to a succinct list of those names that are most likely to cause patient harm due to their confusability.

Pairs and groups of medicine names were identified by a risk matrix based on:

- The **likelihood** that the names would be confused
- The **potential severity** (consequence) of this confusion.

The assessment methodology which arrived at the severity risk scores is explained in detail in *Stage 2 Prioritisation of medicine name pairs for Tall Man application* beginning on page 6 of this report.

Name 1	Name 2	Composite Similar Score	Similarity Rating	Severity Rating	Risk Rating
Akamin (minocycline)	Aclin (sulindac)	54.548	2	Major	Extreme
Aratac (amiodarone)	Aropax (paroxetine)	50.831	2	Major	Extreme
Avastin (bevacizumab)	Avaxim (Hepatitis A vaccine)	45.003	3	Catastrophic	Extreme
Atropt (atropine)	Azopt (brinzolamide)	76.669	1	Moderate	Extreme
Cefoxitin	Cefotaxime	62	1	Major	Extreme
Cefoxitin	Ceftriaxone	61.815	1	Moderate	Extreme
Cephalothin	Cephazolin	70.911	1	Moderate	Extreme
Cyclizine	Cycloblastin	55	2	Major	Extreme
Cyclosporin	Cycloserine	62.274	1	Major	Extreme
Dactinomycin	Daptomycin	59.581	1	Catastrophic	Extreme
Dilaudid (hydromorphone)	Dilantin (phenytoin)	53.125	2	Catastrophic	Extreme
Daunorubicin	Doxorubicin	70	1	Major	Extreme

Doloxene	Doxycycline	59	1	Moderate	Extreme
Ambisome (amphotericin - liposomal)	Fungizone (amphotericin B)	57.223	2	Catastrophic	Extreme
Humalog	Humulin	75.003	1	Moderate	Extreme
Hydrea (hydroxyurea)	Hydrene (hydrochlorothiazide - triamterene)	59.999	1	Major	Extreme
Morphine	Hydromorphone	50	3	Catastrophic	Extreme
Alkeran (melphalan)	Leukeran (chlorambucil)	58.75	1	Catastrophic	Extreme
Metohexal (metoprolol)	Mellihexal (gliclazide)	59	1	Moderate	Extreme
Alkeran (melphalan)	Myleran (bisulfan)	54.998	2	Catastrophic	Extreme
Leukeran (chlorambucil)	Myleran (busulfan)	60.625	1	Major	Extreme
Nimodipine	Nifedipine	71	1	Major	Extreme
Moxifloxacin	Norfloxacin	64	1	Moderate	Extreme
Norvasc (amlodipine)	Normison (temazepam)	59.375	1	Moderate	Extreme
Novomix (insulin aspart (rys) - combination rapid and intermediate acting)	Novorapid (insulin aspart (rys) - rapid acting)	72.777	1	Moderate	Extreme
Carbamazepine	Oxcarbazepine	64.039	1	Moderate	Extreme
Primaxin (cilastatin-imipenem)	Primacin (primaquine)	61.25	1	Moderate	Extreme
Primacor (milrinone)	Primaxin (cilastatin-imipenem)	58.125	2	Major	Extreme
Infliximab	Rituximab	55	2	Major	Extreme
Depo-Medrol (methylprednisolone)	Solu-Medrol (methylprednisolone)	59.548	1	Moderate	Extreme
Sirolimus	Tacrolimus	60.5	1	Major	Extreme
Toradol (ketorolac)	Tramadol	55.8	2	Major	Extreme
Isotretinoin	Tretinoin	64.581	1	Moderate	Extreme

Trimipramine	Trimeprazine	63.331	1	Moderate	Extreme
Vinblastine	Vincristine	60.911	1	Major	Extreme
Actonel (risedronate)	Actos (pioglitazone)	55.003	2	Moderate	High
Aldactone (sprionolactone)	Aldomet (methyldopa)	46.295	3	Moderate	High
Aldomet (methyldopa)	Alodorm (nitrazepam)	52.5	2	Minor	High
Alphapress (hydralazine)	Alphapril (enalapril)	67.5	1	Minor	High
Amitriptyline	Aminophylline	48.461	3	Moderate	High
Amlodipine	Amitriptyline	55	2	Moderate	High
Amiodarone	Amlodipine	52	2	Moderate	High
Amaryl (glimepiride)	Amoxil (amoxycillin)	42.5	4	Major	High
Aratac (amiodarone)	Arabloc (leflunomide)	49.998	3	Moderate	High
Arthrexin (indomethacin)	Aurorix (moclobemide)	49.998	3	Moderate	High
Apomine (apomorphine)	Avomine (promethazine)	59.997	1	Minor	High
Azathioprine	Azithromycin	48.331	3	Major	High
Erythromycin	Azithromycin	64.581	1	Minor	High
Bisoprolol	Bisacodyl	55	2	Moderate	High
Bumetanide	Budesonide	51.5	2	Minor	High
Carafate (sucralfate)	Caltrate (calcium carbonate)	58.125	2	Minor	High
Carvedilol	Captopril	45.5	3	Moderate	High
Carbimazole	Carbamazepine	50.578	2	Moderate	High
Cefoxitin	Cefepime	55	2	Minor	High
Ceftazidime	Cefepime	68.185	1	Minor	High
Cefepime	Cefotaxime	62	1	Minor	High
Ceftazidime	Cefotaxime	67.726	1	Minor	High
Cefoxitin	Ceftazidime	55	2	Moderate	High
Cefepime	Ceftriaxone	51.815	2	Moderate	High

Cefotaxime	Ceftriaxone	58.185	2	Minor	High
Ceftazidime	Ceftriaxone	58.185	2	Minor	High
Cephalothin	Ceftriaxone	58.637	1	Minor	High
Celapram (citaolopram)	Celebrex (celecoxib)	53.3	2	Minor	High
Cefepime	Cephalothin	45.452	3	Moderate	High
Cefotaxime	Cephalothin	55	2	Moderate	High
Ceftazidime	Cephalothin	48.637	3	Major	High
Cephalexin	Cephalothin	50.911	2	Moderate	High
Cefepime	Cephazolin	58	2	Moderate	High
Cefotaxime	Cephazolin	51.5	2	Minor	High
Cefoxitin	Cephazolin	55	2	Minor	High
Ceftazidime	Cephazolin	65	1	Minor	High
Clomipramine	Chlorpromazine	54.998	2	Moderate	High
Clarithromycin	Ciprofloxacin	45.002	3	Moderate	High
Cipramil (citalopram)	Ciproxin (ciprofloxacin)	53.125	2	Moderate	High
Carboplatin	Cisplatin	60.001	1	Minor	High
Clomipramine	Clomiphene	56.669	2	Moderate	High
Plavix (clopidogrel)	CoPlavix (aspirin - clopidogrel)	68.3	1	Minor	High
Coumadin (warfarin)	Coversyl (perindopril)	41.875	4	Major	High
Ifosfamide	Cyclophosphamide	43.434	4	Major	High
Depo-Medrol (methylprednisolone)	Depo-Provera (medroxyprogesterone acetate)	51.25	2	Moderate	High
Deptran (doxepin)	Deralin (propranolol)	57.498	2	Minor	High
Oxazepam	Diazepam	53.125	2	Minor	High

Amoxycillin	Dicloxacillin	55.383	2	Minor	High
Dipyridamole	Disopyramide	53.331	2	Moderate	High
Diprivan (propofol)	Ditropan (oxybutynin)	43.75	4	Catastrophic	High
Duloxetine	Doloxene (dextropropoxyphene)	55.5	2	Minor	High
Dothiepin	Doxepin	64.169	1	Minor	High
Duloxetine	Fluoxetine	56.5	2	Minor	High
Flucloxacillin	Fluoxetine	47.501	3	Moderate	High
Fluoxetine	Fluvoxamine	55.226	2	Minor	High
Glibenclamide	Gliclazide	53.266	2	Moderate	High
Glibenclamide	Glimepiride	47.695	3	Moderate	High
Gliclazide	Glimepiride	45.685	3	Moderate	High
Glipizide	Glimepiride	57.726	2	Moderate	High
Glibenclamide	Glipizide	62.305	1	Minor	High
Gliclazide	Glipizide	56.5	2	Moderate	High
Hydralazine	Hydrochlorothiazide	51.5	2	Moderate	High
Daunorubicin	Idarubicin	45.831	3	Major	High
Doxorubicin	Idarubicin	46.363	3	Major	High
Neoral (cyclosporin)	Inderal (propranolol)	44.4	4	Major	High
Isopto Homatropine (homatropine)	Isopto Carpine (pilocarpine)	66.9	1	Minor	High
Janumet (metformin/sitagliptin)	Januvia (sitagliptin)	75.003	1	Minor	High
Ketalar (ketamine)	Ketorolac	40	4	Major	High
Lamictal (lamotrigine)	Lamisil (chlorpromazine)	48.75	3	Moderate	High
Lamivudine	Lamotrigine	48.863	3	Moderate	High
Lantus (insulin glargine)	Lanvis (thioguanine)	46.669	3	Major	High

Lamictal (lamotrigine)	Largactil (terbinafine)	53.892	2	Moderate	High
Lipidil (fenofibrate)	Lipazil (gemfibrozil)	60.001	1	Minor	High
Lipitor (atorvastatin)	Loniten (minoxidil)	55	2	Minor	High
Clonazepam	Lorazepam	62.5	1	Minor	High
Diazepam	Lorazepam	47.777	3	Moderate	High
Losec (omeprazole)	Lovan (fluoxetine)	52.5	2	Minor	High
Meruvax (rubella vaccine)	Merieux (rabies vaccine)	45	4	Catastrophic	High
Methadone	Methylphenidate	43	4	Major	High
Mobilis (prioxicam)	Movalis (meloxicam)	57.501	2	Minor	High
Nexavar (sorafenib)	Nexium (esomeprazole)	40	4	Major	High
Nizatidine	Nimodipine	47	3	Moderate	High
Neurontin (gabapentin)	Noroxin (norfloxacin)	56.392	2	Minor	High
MS Contin (morphine)	OxyContin (oxycodone)	60.277	1	Minor	High
Oxynorm (oxycodone)	OxyContin (oxycodone)	52.5	2	Moderate	High
Docetaxel	Paclitaxel	48.5	3	Major	High
Paxtine (paroxetine)	Pariet (rabeprazole)	55	2	Minor	High
Fluoxetine	Paroxetine	73	1	Minor	High
Pexsig (perhexiline)	Pristiq (desvenlafaxine)	48	3	Moderate	High
Promethazine	Prochlorperazine	54.375	2	Moderate	High
Propranolol	Propofol	41.363	4	Catastrophic	High
Prograf (tacrolimus)	Prozac (fluoxetine)	50.003	3	Major	High
Risperidone	Ropinirole	46.815	3	Moderate	High
Augmentin Duo Forte* (amoxycillin - clavulanate)	Septrin Forte* (sulfamethoxazole - trimethoprim)	43.159	4	Major	High
Quetiapine	Sertraline	50	3	Moderate	High

Alprim (trimethoprim)	Solprin (aspirin)	75.003	1	Minor	High
Solu-Cortef (hydrocortisone)	Solu-Medrol(methylprednisolone)	58.863	1	Minor	High
Sulfasalazine	Sulfadiazine	81.344	1	Minor	High
Sitagliptin	Sumatriptan	53.185	2	Minor	High
Taxol	Taxotere	49.375	3	Major	High
Topamax (topiramate)	Tofranil (imipramine)	45.5	3	Moderate	High
Temodal (temozolomide)	Tramadol	50	3	Moderate	High
Tegretol (carbamazepine)	Trental (oxpentifylline)	52.5	2	Moderate	High
Trimeprazine	Trimethoprim	51.25	2	Moderate	High
Imipramine	Trimipramine	60.419	1	Minor	High
Valaciclovir	Valganciclovir	62.499	1	Minor	High
Naltrexone	Valtrex (valaciclovir)	49.2	3	Moderate	High
Xalatan (latanoprost)	Xalacom (latanoprost - timolol maleate)	75.003	1	Minor	High
Zinvit (zinc - vitamin C)	Zinnat (cefuroxime)	56.669	2	Moderate	High
Zoloft (sertraline)	Zocor (simvastatin)	50.831	2	Minor	High
Zocor (simvastatin)	Zoton (lansoprazole)	54	2	Minor	High
Adalat (nifedipine)	Aldomet (methyldopa)	34.997	5	Moderate	Low
Amorolfine	Aminophylline	34.104	5	Moderate	Low
Amisulpride	Amlodipine	35.5	5	Moderate	Low
Aricept (donepezil)	Arimidex (anastrazole)	49.2	3	Minimum	Low
Arthrexin (indomethacin)	Asasantin (aspirin - dipyridamole)	34.5	5	Minor	Low
Alphapress	Atenolol	37.5	5	Minor	Low
Avandia (rosiglitazone)	Avanza (mirtazepine)	32.223	5	Minor	Low

Bimatoprost	Brimonidine	32.274	5	Minor	Low
Cefaclor	Cefepime	30.625	5	Moderate	Low
Cephalexin	Cefepime	31.5	5	Moderate	Low
Cefaclor	Cefotaxime	28	5	Minor	Low
Cefaclor	Cefoxitin	31.108	5	Minor	Low
Cefaclor	Ceftazidime	25.452	5	Moderate	Low
Cephalexin	Ceftazidime	28.637	5	Moderate	Low
Cefaclor	Ceftriaxone	31.815	5	Moderate	Low
Cephalexin	Ceftriaxone	28.637	5	Minor	Low
Cefaclor	Cephalexin	45.5	3	Minimum	Low
Cefaclor	Cephalothin	31.815	5	Minor	Low
Cefaclor	Cephazolin	31.5	5	Moderate	Low
Tenopt (timolol maleate)	Cosopt (dorzolamide hydrochloride - timolol maleate)	39.169	4	Minimum	Low
Cyproterone	Cyproheptadine	49.9	3	Minimum	Low
Ethambutol	Eformoterol	28	5	Moderate	Low
Deptran (doxepin)	Endep (amitriptyline)	37.503	5	Minor	Low
Estrofem (Oestradiol)	Escitalopram	36.6	5	Minimum	Low
Accupril (quinapril)	Fosinopril	44.5	4	Minimum	Low
Capoten (captopril)	Gopten (trandolapril)	37.502	5	Minimum	Low
Imdur (isosorbide mononitrate)	Ibilex (cephalexin)	22.5	5	Moderate	Low
Tenormin (atenolol)	Imuran (azathioprine)	28.3	5	Moderate	Low
Gopten (trandolapril)	Isoptin (verapamil)	37.5	5	Moderate	Low
Amikin (amikacin)	Kineret (anakinra)	24.997	5	Moderate	Low

Kliogest (norethisterone - oestradiol)	Kliovance (norethisterone - oestradiol)	49.2	3	Minimum	Low
Nexium (esomeprazole)	Lexapro (escitalopram)	35.3	5	Minimum	Low
Crestor (rosuvastatin)	Lipitor (atorvastatin)	44.5	4	Minimum	Low
Levlen (ethinyleostradiol - levonorgestrel)	Logynon (ethinyleostradiol - levonorgestrel)	29.999	5	Minimum	Low
Lasix (frusemide)	Luvox (fluvoxamine)	33	5	Moderate	Low
Meningitec (Neisseria meningitidis vaccine)	Mencevax (Neisseria meningitidis vaccine)	31.5	5	Moderate	Low
Metoclopramide	Metoprolol	37.501	5	Minor	Low
Metoclopramide	Metronidazole	32.503	5	Moderate	Low
Microlax	Microlut (levonorgestrel)	50.4	3	Minimum	Low
Nitrazepam	Mirtazapine	32.952	5	Moderate	Low
Paroxetine	Mirtazapine	29.774	5	Minimum	Low
Maxolon (metoclopramide)	Moxacin (amoxycillin)	32.502	5	Minor	Low
Pegasys (peginterferon alfa-2a - ribavirin)	Pegatron (peginterferon alfa-2b - ribavirin)	49.2	3	Minimum	Low
Isordil (isosorbide mononitrate)	Plendil (felodipine)	37.497	5	Moderate	Low
Pyroxin (pyroxidine)	Priorix (Measles, Mumps, Rubella vaccine)	35	5	Minimum	Low
Losec (omeprazole)	Prozac (fluoxetine)	35	5	Minor	Low
Olanzapine	Quetiapine	36.5	5	Minor	Low
Amaryl (glimepiride)	Reminyl (galantamine)	29.997	5	Minor	Low
Dimirel (glimepiride)	Reminyl (galantamine)	29.997	5	Moderate	Low
Seretide (fluticasone/salmeterol)	Serevent (salmeterol)	43.75	4	Minimum	Low

Sunitinib	Sorafenib	36.108	5	Moderate	Low
Inspra (eplenerone)	Spiriva (tiotropium)	15.001	5	Minor	Low
Fluvoxamine	Thyroxine	35.2	5	Minor	Low
Topamax (topirimate)	Toprol-XL (metoprolol)	34.723	5	Moderate	Low
Valcyte (valganciclovir)	Valtrex (valaciclovir)	47.498	3	Minimum	Low
Xanax (alprazolam)	Zantac (ranitidine)	34.169	5	Minor	Low
Cozaar (losartan)	Zocor (simvastatin)	27.5	5	Minor	Low
Zolpidem	Zolmitriptan	36.25	5	Minor	Low
Zolpidem	Zopiclone	45	4	Minimum	Low
Zofran (ondansetron)	Zoton (lansoprazole)	37.5	5	Minor	Low
Zostrix (capsaicin)	Zovirax (aciclovir)	44.998	4	Minimum	Low
Diovan (valsartan)	Zyban (bupropion)	22.5	5	Moderate	Low
Lipitor (atorvastatin)	Zyrtec (cetirizine)	17.5	5	Minor	Low
Zocor (simvastatin)	Zyrtec (cetirizine)	29.169	5	Minor	Low
Abelcet (amphotericin B - phospholipid)	Amphotericin B	30.419	5	Catastrophic	Moderate
Amantadine	Cimetidine	43.5	4	Minor	Moderate
Cortisone	Cordarone (amiodarone)	43.892	4	Moderate	Moderate
Alprazolam	Lorazepam	58.5	2	Minimum	Moderate
Valaciclovir	Aciclovir	54.581	2	Minimum	Moderate
Anzemet (dolasetron)	Aldomet (methyldopa)	44.998	4	Minor	Moderate
Akamin (minocycline)	Alepam (oxazepam)	42.5	4	Minor	Moderate
Alodorm	Alprazolam	38	4	Minor	Moderate
Amlodipine	Amiloride	58.5	2	Minimum	Moderate
Aminophylline	Amiodarone	34.234	5	Major	Moderate
Amoxycillin	Ampicillin	60.911	1	Minimum	Moderate

Aurorix (moclobemide)	Aropax (paroxetine)	45	4	Moderate	Moderate
Auspril (enalapril)	Auscap (fluoxetine)	50	3	Minor	Moderate
Beclomethasone	Betamethasone	54.999	2	Minimum	Moderate
Bupropion	Busprione	47.777	3	Minor	Moderate
Cardizem (diltiazem)	Cardiprin (aspirin)	50.277	3	Minor	Moderate
Cephalexin	Cefotaxime	45	4	Minor	Moderate
Cephalexin	Cefoxitin	45	4	Minor	Moderate
Cephazolin	Ceftriaxone	48.637	3	Minor	Moderate
Capadex (dextropropoxyphene - paracetamol)	Cephalexin	39	4	Minor	Moderate
Ciprofloxacin	Cephalexin	44.4	4	Moderate	Moderate
Cefoxitin	Cephalothin	61.815	1	Minimum	Moderate
Cephalexin	Cephazolin	49	3	Minor	Moderate
Norfloxacin	Ciprofloxacin	48.078	3	Minor	Moderate
Escitalopram	Citalopram	69	1	Minimum	Moderate
Clomid (clomiphene)	Clomipramine	41.5	4	Minor	Moderate
Imipramine	Clomipramine	69.581	1	Minimum	Moderate
Alprazolam	Clonazepam	46.5	3	Minor	Moderate
Clonazepam	Clonidine	40	4	Moderate	Moderate
Colchicine	Cortisone	38	4	Moderate	Moderate
Daonil (glibenclamide)	Deseril (methysergide)	40.002	4	Minor	Moderate
Desferal (desferrioxamine)	Deseril (methysergide)	48.125	3	Minor	Moderate
Desvenlafaxine	Dexamphetamine	45	4	Moderate	Moderate
Dexamphetamine	Dexmethasone	40	4	Moderate	Moderate
Diaformin (metformin)	Diamicron (gliclazide)	46.392	3	Minor	Moderate

Didronel (disodium etidronate)	Didrocal (calcium disodium etidronate)	82.5	1	Minimum	Moderate
Difflam (benzydamine hydrochloride)	Differin (adapalene)	44.375	4	Minor	Moderate
Diflucan (fluconazole)	Diprivan (propofol)	37.5	5	Catastrophic	Moderate
Deptran (doxepin)	Ditropan (oxybutynin)	38.125	4	Minor	Moderate
Dithiazide (hydrochlorthiazide)	Ditropan (oxybutynin)	41.5	4	Moderate	Moderate
Dobutamine	Dopamine	59	1	Minimum	Moderate
Docetaxel	Doxorubicin	29.089	5	Catastrophic	Moderate
Ezetrol (ezetimibe)	Edronax (reboxetine)	45	4	Minor	Moderate
Famotidine	Felodipine	47	3	Minor	Moderate
Dicloxacillin	Flucloxacillin	70	1	Minimum	Moderate
Flucloxacillin	Fluconazole	45	4	Moderate	Moderate
Gemfibrozil	Gabapentin	39.774	4	Minor	Moderate
Imdur (isosorbide mononitrate)	Imuran (azathioprine)	43.331	4	Moderate	Moderate
Kalma (alprazolam)	Kaluril (amiloride hydrochloride)	45	4	Minor	Moderate
Kaletra (lopinavir - ritonavir)	Keppra (levetiracetam)	40	4	Moderate	Moderate
Keflex (cephalexin)	Keppra (levetiracetam)	44.169	4	Moderate	Moderate
Ketotifen	Ketoprofen	49	3	Minor	Moderate
Lasix (frusemide)	Lescol (fluvastatin)	44.169	4	Moderate	Moderate
Leucovorin (calcium folinate)	Leukeran (chlorambucil)	28	5	Major	Moderate
Lipex (simvastatin)	Lipitor(atorvastatin)	65	1	Minimum	Moderate
Lipitor (atorvastatin)	Lipostat (pravastatin)	69.2	1	Minimum	Moderate
Loratadine	Lorazepam	39	4	Minor	Moderate
Lasix (frusemide)	Losec (omeprazole)	50	3	Minor	Moderate

Lovan (fluoxetine)	Luvox (fluvoxamine)	42.5	4	Minor	Moderate
Mogadon (nitrazepam)	Maxolon (metoclopramide)	45	4	Moderate	Moderate
Sulfasalazine	Mesalazine	47.883	3	Minor	Moderate
Metformin	Metronidazole	39.234	4	Minor	Moderate
Metoclopramide	Midazolam	34.999	5	Catastrophic	Moderate
Olanzapine	Mirtazapine	43.185	4	Moderate	Moderate
Quetiapine	Mirtazapine	40	4	Moderate	Moderate
Mifepristone (RU486)	Misoprostol	43.75	4	Moderate	Moderate
Monoplus (fosinopril - hydochlorthiazide)	Mobilis (piroxicam)	50	3	Minor	Moderate
Monopril (fosinopril)	Monoplus (fosinopril - hydochlorthiazide)	68.125	1	Minimum	Moderate
Nizatidine	Nifedipine	49.5	3	Minor	Moderate
Mirtazapine	Nitrazepam	41.815	4	Minor	Moderate
Norimin (ethinyleostradiol - norethisterone)	Norinyl (norethisterone - mestranol)	60.001	1	Minimum	Moderate
Noroxin (norfloxacin)	Normison (temazepam)	44.2	4	Moderate	Moderate
Nitrazepam	Nortriptyline	32.498	5	Major	Moderate
Oxycodone	Oxybutynin	44	4	Moderate	Moderate
Panafcort (prednisone)	Panafcortelone (prednisolone)	75.003	1	Minimum	Moderate
Suxamethonium	Pancuronium	39.617	4	Moderate	Moderate
Proven (ibuprofen)	Paroven (hydroxyethylrutosides)	59.999	1	Minimum	Moderate
Paxam (clonazepam)	Paxtine (paroxetine)	45	4	Minor	Moderate
Pseudoephidrine	Physeptone	28.331	5	Catastrophic	Moderate

Prazosin	Pravastatin	45	4	Moderate	Moderate
Panadeine Forte (paracetamol - codeine)	Prednefrin Forte (phenylephrine - prednisolone)	41.566	4	Moderate	Moderate
Resprim Forte (sulfamethoxazole - trimethoprim)	Prednefrin Forte (phenylephrine - prednisolone)	37.1	5	Major	Moderate
Prednisolone	Prednisone	73.331	1	Minimum	Moderate
Premia (medroxyprogesterone - oestrogens)	Premarin (oestrogens)	53.75	2	Minimum	Moderate
Pramin (metoclopramide)	Pressin (prazosin)	49.998	3	Minor	Moderate
Prednisolone	Primidone	40	4	Moderate	Moderate
Pethidine	Prothiaden (dothiepin)	38.5	4	Minor	Moderate
Rifampicin	Rifabutin	57	2	Minimum	Moderate
Prednisolone	Risperidone	44.169	4	Moderate	Moderate
Rocaltrol (calcitriol)	Roaccutane (isotretinoin)	38	4	Moderate	Moderate
Reminyl (galantamine)	Robinul (glycopyrolate)	39.998	4	Minor	Moderate
Salbutamol	Salmeterol	47	3	Minor	Moderate
Seroquel (quetiapine)	Sertraline	43	4	Moderate	Moderate
Saquinavir	Sinequan (doxepin)	35.5	5	Major	Moderate
Seroquel (quetiapine)	Sinequan (doxepin)	41.25	4	Moderate	Moderate
Sinequan (doxepin)	Singulair (montelukast)	46.108	3	Minor	Moderate
Suboxone (buprenorphine - naltrexone)	Subutex (buprenorphine)	55	2	Minimum	Moderate
Sotalol	Sudafed (phenylephrine)	29.997	5	Major	Moderate
Ticarcillin	Tacrolimus	34.315	5	Major	Moderate

Melphalan	Thyroxine	16.669	5	Major	Moderate
Thiamine	Thyroxine	45	4	Minor	Moderate
Anafranil (clomipramine)	Tofranil (imipramine)	62.7	1	Minimum	Moderate
Tambocor (flecainide)	Topamax (topiramate)	43	4	Moderate	Moderate
Vasocardol (diltiazem)	Veracaps (verapamil)	39.5	4	Minor	Moderate
Venlafaxine	Verapamil	40	4	Moderate	Moderate
Xeloda (capecitabine)	Xenical (orlistat)	35.002	5	Major	Moderate
Zocor (simvastatin)	Zestril (lisinopril)	39.999	4	Minor	Moderate
Sumatriptan	Zolmitriptan	52.726	2	Minimum	Moderate
Zestril (lisinopril)	Zyprexa (olanzapine)	39.997	4	Moderate	Moderate
Zantac (ranitidine)	Zyrtec (cetirizine)	40	4	Minor	Moderate
Zestril (lisinopril)	Zyrtec (cetirizine)	42.497	4	Minor	Moderate
Zyprexa (olanzapine)	Zyrtec (cetirizine)	50	3	Minor	Moderate
Zovirax (aciclovir)	Zyvox (linezolid)	35.002	5	Major	Moderate

Appendix D: National list of Australian medicines names with Tall Man lettering applied

This list has been compiled to include look-alike, sound-alike names that 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 medicines names and associated products will be confused and the overall patient harm that may occur if this confusion occurred.

Medicines names are list in look-alike, sound-alike pairs or groups. An alphabetical version of National Tall Man Lettering is available from the Commission web site at www.safetyandquality.gov.au/our-work/medication-safety/national-tall-man-lettering/

actoNEL	actoS
aKAMin	aCLin
alDOMET	alDACTONE
	alODORM
alphaprESS	alphaprIL
amARYl	amOXIl
amIODAROne	amLODIPIne
amLODIPIne	amITRIPTYLIne
amITRIPTYLIne	amINOPHYLLIne
aPomine	aVomine
arATAC	arOPAX
	arABLOC
aTRopt	aZopt
azATHIOPRINE	azITHROMYCIN
ERYthromycin	
bisOPROLOl	bisACODYl
buMETANide	buDESONide
caRAFate	caLTRate
CARBAMazepine	OXCARBazepine
	carbIMAZOLe*
caRVEDILOl	caPTOPRIl
celAPRAM	celEBREX
ciprAMIL	ciprOXIN
cLARITHROMYcin	cIPROFLOXAcin
cLOMIPRAMIne	cLOMIPHEne

	cHLORPROMAZIne
coUMADIN	coVERSYL
cyclosPORIN	cyclosERINE
DEPO-medrol	SOLU-medrol
DEPO-medrol	depo-PROVERA*
solu-CORTEF*	SOLU-medrol
dePTRAn	deRALIn
dilaUDID	dilaNTIN
diPRIVan	diTROPan
diPYRIDAMOLe	diSOPYRAMIDe
doTHIEpin	doXEpin
humALOG	humULIN
hydreA	hydreNE
hydrALAZINe	hydrOCHLOROTHIAZIDe
isopto HOMATROpine	isopto CARpine
ISOtretinoin	tretinoin
januMET	januVIA
ketALAR	ketOROLAC
laMICTAl	laRGACTIl
	laMISIl
lamIVUDine	lamOTRIGine
lanTUs	lanVIs
lipIDil	lipAZil
loSEC	loVAN
methADONe	methYLPHENIDATe
merUVAx	merIEUx
meTOhexal	meLLIhexal
MOXIfloxacin	NORfloxacin
moBILis	moVALis
morphine*	HYDROmorphone*
NEOral	INDEral
nEURONTin	nOROXin

nexAVAR	nexIUM
niMODIPine	niFEDIPine
	niZATIDine
norVASC	norMISON
novoMIX	novoRAPID
oxyCONTIN	MS Contin*
	oxyNORM
paXTINE	paRIET
pEXSIG	pRISTIQ
primaXIN	primaCOR
	primaCIN*
proGRAF	proZAC
proMETHazine	proCHLORPERazine
propRANOLol	propOFol
QUETIAPine	SERTRALine
rISPERIDONe	rOPINIROLe
sITAGLIPTIn	sUMATRIPTAn
SIrolimus	TACrolimus
sulfaSALazine	sulfaDIazine
toPAMAX	toFRANIL
tEGRETOl	tRENTAl
tRAMadol	tEMOdal*
	tORadol
trimEPRAZINE	trimETHOPRIM
	trimIPRAMINE
imipramine*	trimIPRAMINE
valAciclovir	valGANciclovir
xalaTAN	xalaCOM
zinVIt	zinNAt
zoCOR	zoTON
zoLOFT	zoCOR

Agents used predominantly in cancer therapy	
cISplatin	cARBOplatin
cyclIZINE	cyclOBLASTIN
daCTINomycin	daPTomycin
DAUNOrubicin	DOXOrubicin
	IDArubicin
DOCEtaxel	PACLItaxel
IFOSFamide	CYCLOPHOSPHamide
INFLIximab	RITUximab
taxoL	taxoTERE
vinBLASTine	vinCRISTine
	vinORELBine
avaSTIN	avaXIM
ALKeran	LEUKeran
	MYLeran

Larger groups of agents

Cephalosporins
cefEPIME
cefOTAXIME
cefOXITIN
cefTAZIDIME
cefTRIAXONE
cefALOTIN
cephaLEXin
cephaZOLin
Benzodiazepines
CLONazepam
DIazepam
OXazepam
LORazepam
SSRI / SNRI
fluoxetine
DULoxetine
PARoxetine
fluVOXAMine
Sulphonylurea Agents
gliBENCLAMide
gliCLAZide
gliMEPIRide
gliPIZide

Appendix E: Tall Man Mid rule exceptions

Recent studies conducted for the National Health System (UK) *Connecting for Health* program have evaluated the effectiveness of Tall Man names constructed by various methods, and concluded that a method dubbed Mid Tall Man lettering was the most effective and most easily applied in a systematic fashion[19].

For some larger groups of confusable medicines names, such as the cephalosporins for instance, application of Mid Tall Man may be problematic.

For the application of Tall Man lettering, names were grouped as appropriate. For example, the confusable name pairs aldomet and aldactone and aldomet and alodorm were grouped before the application of Tall Man lettering. Where there was no natural grouping, or where no natural grouping seemed logical, Tall Man lettering was applied first to the name pair (or natural grouping) that carried the highest risk, and then subsequent pairs.

In this way, the main risks of confusion have been addressed more satisfactorily than through rigid application of the Mid rule.

Medicines names included in the standard that are exceptions to the Mid rule

Carbimazole
Hydromorphone
Morphine
MS Contin (morphine sulphate)
Temodal (temozolomide)
Depo-Provera (medroxyprogesterone acetate)
Solu-Cortef (hydrocortisone)
Primacin (primaquine)
Imipramine
Fluoxetine

Despite being found to be a significant risk to patient safety, some confusable medicine name pairs were excluded from the standard list of Tall Man names. This was mainly due to the fact that the names did not share adequate orthographic similarity to warrant the use of Tall Man. Generally, this was considered to be the case if Tall Man names did not contain at least two lower case letters. An example is the name pair Fungizone and Ambisome. Whilst this pair of medicines has caused considerable confusion, resulting in patient harm, use of Tall Man lettering, especially Mid format Tall Man lettering, is unlikely to reduce the confusability of the two names. For these medicines, confusion likely arises from the fact that the two products are different formulations of the same active ingredient. Other interventions should be made to reduce harm from such confusable products.

Medicine name pairs excluded from the standard

Arthrexin (indomethacin)	Aurorix (moclobemide)
Doloxene	Doxycycline
Duloxetine	Doloxene (dextropropoxyphene)
Lipitor (atorvastatin)	Loniten (minoxidil)
Naltrexone	Valtrex (valaciclovir)
Plavix	CoPlavix
Fluoxetine	Flucloxacliin

References

1. Phatak HM, Cady PS, Heyneman CA, Culbertson VL. Retrospective Detection of Potential Medication Errors Involving Drugs with Similar Names. Journal of the American Pharmacists Association. 2005;45:616-24.
2. Hoffman JM, Proulx SM. Medication Errors Caused by Confusion of Drug Names. Drug Safety. 2003;26(7):445-52.
3. Pharmaceutical Defence Limited. Ninety-Sixth Annual Report and Statement of Accounts for the year ended 30 June 2008. Hawthorn, Victoria; 2008.
4. Davis NM, Cohen MR, Teplitsky B. Look-alike and sound-alike drug names: the problem and the solution. Hospital Pharmacy. 1992;27(2):95-8, 102-5, 8-10.
5. Practices IfSM. ISMP's List of Confused Drug Names. 2010 [cited October, 2010]; Available from: http://www.ismp.org/Tools/confuseddrugnames.pdf
6. United States Pharmacopeia. Use Caution - Avoid Confusion. USP Quality Review; 2001.
7. FIlik R, Purdy K, Gale A, Gerrett D. Drug name confusion: evaluating the effectiveness of capital ("Tall Man") letters using eye movement data. Social Science and Medicine. 2004;59:2597-601.
8. FIlik R, Purdy K, Gale A, Gerrett D. Labeling of Medicines and Patient Safety: Evaluating Methods of Reducing Drug Name Confusion. Human Factors. 2006;48(1):39-47.
9. Gabriele S. The Role of Typography in Differentiating Look-Alike/Sound-Alike Drug Names. Healthcare Quarterly. 2006;9(Special Issue):88-95.
10. Emmerton L, Rizk M. Look-Alike and Sound-Alike Medicines: Reducing the Risk of Errors: The University of Queensland; 2010.
11. Lambert B, Yu C, Thirumalai M. A system for multiattribute drug product comparison. Journal of Medical Systems. 2004;28(1):31-56.
12. Kondrak G, Dorr B. Automatic identification of confusable drug names. Artificial Intelligence in Medicine. 2006;36:29-42.
13. Lambert B, Donderi D, Senders J. Similarity of Drug Names: Comparison of Objective and Subjective Measures. Psychology and Marketing. 2002 July/August 2002;19(7-8):641-61.
14. Lambert BL. Predicting look- and sound-alike medication errors. American Journal of Health-System Pharmacy. 1997;54:1161–71.
15. http://webdocs.cs.ualberta.ca/~ab31/strcmp2/ [cited September 2010]; Available from: http://webdocs.cs.ualberta.ca/~ab31/strcmp2/
16. National Coordinating Centre for Medication Error Reporting and Prevention. NCC MERP Index for Categorizing Medication Errors. 2001 [cited; Available from: http://www.nccmerp.org/pdf/indexBW2001-06-12.pdf
17. National Patient Safety Agency. A risk matrix for managers. 2008 [cited 4/11/2010]; Available from: http://www.nrls.npsa.nhs.uk/resources/?EntryId45=59833

18. Van de Vreede M, McRae A, Wiseman M, Dooley M. Successful Introduction of Tallman Letters to Reduce Medication Selection Errors in a Hospital Network. Journal of Pharmacy Practice and Research. 2008;38(4):263-6.

19. Gerrett D, Gale A, Darker IT, FIlik R, Purdy KJ. Final Report of The Use of Tall Man Lettering to Minimise Selection Errors of Medicine Names in Computer Prescribing and Dispensing Systems: NHS Connecting for Health 2009.

20. Institute for Safe Medication Practices. ISMP updates its list of drug name pairs with TALL man letters. ISMP Medication Safety Alert. 2010;15(23):1-3.