

National Mixed-Case Lettering List

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| **Purpose** |
| **To present an update and renaming of the *National Tall Man Lettering List* published in 2020.** |

# Introduction

The Australian Commission on Safety and Quality in Health Care (the Commission) is responsible for the development and stewardship of the National Mixed‑Case Lettering List (the List).

This document is an update and renaming of the National Tall Man Lettering List published in 2020. This document has been updated by the Commission based on the changes to the Australian Register of Therapeutic Goods, changes to ‘mixed-case’ and ‘Tall Man lettering’ lists published by other countries (United States, Canada and New Zealand), and reported adverse incidents or near misses from hospital networks across Australia.

Medication errors are one of the most reported clinical incidents in acute healthcare settings. While rates of serious harm are low, the prevalence of medication errors is a concern, particularly as many are preventable. Medication incidents related to ‘look-alike, sound-alike’ (LASA) medicine names are one of the most common type of medication error.1-3 In some instances, medication incidents involving LASA medicine names have the potential to cause serious patient harm, such as administering HYDROmorphone instead of morphine.

With several new medicines entering the market each year and in the absence of an effective pre-marketing screening method, LASA medicine names continue to pose a risk to patient safety. Whilst the majority of the medicines on the List are by active ingredient name, a small number of LASA medicine brand names are also included.

# ‘Mixed-case lettering’

‘Mixed-case lettering’ (also referred to as ‘Tall Man lettering’) is a typographic technique that uses selective capitalisation to help make similar looking medicine names more easily distinguishable.4-6 Studies have shown its effectiveness on medicine name confusion error rate7, differentiation accuracy1,8, and perception.9 Whilst other studies have suggested that the evidence is conflicting or suggests ‘mixed-case lettering’ is ineffective.10,11

‘Mixed-case lettering’ uses a combination of lower- and upper-case letters to highlight the differences. For example:

* proGRAF and proZAC
* oBINUTUZumab and oFATUMumab.

Research based on experimental psychology suggests that ‘mixed-case lettering’ purposely disrupts the reading of a medicine name, drawing attention to, or accentuating, one or more differentiating syllables, and potentially preventing erroneous selection of a medicine with a similar name. This technique also alerts the health care professional that the medicine name has the potential for confusion with another medicine name.

The Institute for Safe Medication Practices (ISMP), the International Medication Safety Network (IMSN), the World Health Organization (WHO) and many other organisations have recommended ‘mixed-case’ or ‘Tall Man lettering’ as a strategy to minimise risk associated with LASA medicine names.11-25

# Governance

The Commission has established an expert advisory panel consisting of frontline clinicians and a pharmacy and medication safety academic to advise the Commission on matters related to ‘mixed-case’ (or ‘Tall Man’) lettering. The panel is responsible for making recommendations on the medicine names that need to be included in the List. The panel follows a systematic process to decide on the medicine names that would most benefit from the application of ‘mixed‑case lettering’ to highlight the risk of confusion.

In 2023, the panel considered and recommended changes, based upon local reporting of adverse events and near misses as well as review of international guidance, for instance, the Institute of Safe Medication Practices (ISMP) – for example, the following medicine name has been added to the list of medicines used predominantly in cancer therapy:

* CABAZitaxel.

One of the main recommendations was the renaming of this medication safety strategy to ‘mixed-case lettering’. This was supported by the Commission’s Health Services Expert Advisory Group (HSMEAG). Guidance has also been enhanced to include advice on the implementation of ‘mixed-case lettering’ following local assessment of LASA risk for medicines not included on the List.

The following medicine names have also been added as they appear close together on electronic medication management alphabetical drop-down lists – for example, within a smart infusion pump drug library:

* dexAMETHASOne and dexMEDETOMIDine
* cycLONEX and cycLIZINE
* flucLOXACILLIN and flucONAZOLe and flucYTOSINe.

In 2019, a review of name similarity of monoclonal antibodies (MABs) and tyrosine kinase inhibitors was conducted.26 This review led to the development of a ‘supplementary list’ for thirty-one specialised medicines, which has now been incorporated within this 2023 edition to include the following classes of immuno-modulating medicines:

* Monoclonal antibodies (MABs) (commonly ending in the suffix ‘mab’)
* Tyrosine kinase (factor) inhibitors (TKIs) (commonly ending in the suffix ‘nib’).

# Limitations

The National Mixed-Case Lettering List does not aim to be an exhaustive list of all LASA medicine names (see Risk management). This list has been compiled to include groups (pairs and trios) of LASA medicine names that have been predicted to pose the greatest risks to patient safety at the time of publication. In addition, the Commission has taken the view consistent with published evidence that overuse of the ‘mixed-case’ (or ‘Tall Man’) lettering technique may reduce its effectiveness.

Health service organisations are encouraged to consider implementing other measures such as use of bar code scanners, electronic alerts, or separate storage locations to minimise harm associated with LASA medicines. The [Principles for safe selection and storage of medicines](https://www.safetyandquality.gov.au/our-work/medication-safety/safer-naming-labelling-and-packaging-medicines/safe-selection-and-storage-medicines#principles-for-the-safe-selection-and-storage-of-medicines) provide further advice and examples of risk-reduction strategies with a focus on LASA medicines.

# Guidance for use

Implementation of ‘mixed-case’ (or ‘Tall Man’) lettering should include educating health professionals about the risks associated with LASA medicine names and the application and purpose of ‘mixed-case lettering’.

The [National guidelines for on-screen display of medicines information](https://www.safetyandquality.gov.au/our-work/medication-safety/electronic-medication-management/national-guidelines-for-on-screen-display-of-medicines-information/) and guidance for implementation of [Electronic medication management](https://www.safetyandquality.gov.au/our-work/Medication-safety/Electronic-medication-management/Electronic-Medication-Management-Systems-A-Guide-to-Safe-Implementation/) systems published by the Commission recommend using ‘mixed-case’ (or ‘Tall Man’) lettering.

The Commission supports the use of ‘mixed-case lettering’ as part of a multi-faceted approach to reduce the risk of selection errors by health professionals associated with LASA medicines names.

# Risk management

‘Mixed-case lettering’ should be used by clinicians and health service organisations to support safe selection of medicines in:

* Electronic medication management systems, including prescribing, dispensing and administration systems
* Printed labels used for inpatient dispensing, shelving in pharmacies, and ward medicines storage cupboards
* Drug libraries for smart infusion pumps
* Automated medicines storage and distribution systems.

Tables 1, 2, 3, 4 and 5 on the following pages provide the details of the medicine names with ‘mixed-case’ (or ‘Tall Man’) lettering applied. This information is provided for use as described above.

Given that this List is not exhaustive, it is recommended that health service organisations conduct their own assessment of LASA risk with medicine names. However, health service organisations also need to consider that overuse of the ‘mixed-case’ (or ‘Tall Man’) lettering technique may reduce its effectiveness (see Limitations).

The Commission’s [LASA search tool](https://lasa.azureedge.net/) has been developed to assist with this risk assessment. Information on how to use this tool, including assessment of the ‘clinical risk’, and how to apply ‘mixed-case lettering’ to local medicine formularies, is also available:

* [Information sheet on using the LASA search tool](https://www.safetyandquality.gov.au/publications-and-resources/resource-library/fact-sheet-information-and-instructions-lasa-software-tool)
* [Fact sheet: Principles for the application of ‘mixed‑case lettering’](https://www.safetyandquality.gov.au/publications-and-resources/resource-library/fact-sheet-mixed-case-lettering-principles-application).

# List of medicine names with ‘mixed-case lettering’ applied

Table 1: General list of medicine names arranged into groups of look-alike sound-alike (LASA) medicine name(s)

|  |  |
| --- | --- |
| Medicine name  | LASA medicine name(s) |
| actoNEL | actoS |
| aKAMin | aCLin |
| alDOMET | alDACTONE |
| alODORM |
| amARYl | amOXil |
| amiODAROne | amLODIPine |
| amLODIPine | amiTRIPTYLine |
| amiTRIPTYLine | amiNOPHYLLine |
| aPomine | aVomine |
| arATAC | arOPAX |
| arABLOC |
| ARIPiprazole | RABEprazole |
| aTRopt | aZopt |
| azATHIOPRINE | aziTHROMYCIN |
| ERYthromycin |
| bisOPROLOl | bisACODYl |
| buMETANide | buDESONide |
| caRAFate | caLTRate |
| CARBAMazepine | OXCARBazepine |
| carbiMAZOLe |
| caRVEDILOl | caPTOPRil |
| celAPRAM | celEBREX |
| ciprAMIL | ciprOXIN |
| cLARITHROMYcin | ciPROFLOXAcin |
| cLOMIPRAMine | cLOMIFEne |
| cHLORPROMAZine |
| coUMADIN | coVERSYL |
| ciclosPORIN | cyclosERINE |
| cycLONEX | cycLIZINE |
| DEPO-medrol | SOLU-medrol |
| DEPO-medrol | depo-PROVERA |
| solu-CORTEF | SOLU-medrol |
| dePTRAn | deRALin |
| dexAMETHASOne | dexMEDETOMIDine |
| dilaUDID | dilaNTIN |
| diPRIVan | diTROPan |
| diPYRIDAMOLe | diSOPYRAMIDe |
| doSULepin (doTHiepin) | doXepin |
| flucLOXACILLIN | flucONAZOLe |
| flucYTOSINe |
| humALOG | humULIN |
| hydreA | hydreNE |
| hydrALAZINe | hydrOCHLOROTHIAZIDe |
| isopto HOMATROpine | isopto CARpine |
| iSOtretinoin | tretinoin |
| januMET | januVIA |
| ketALAR | ketOROLAC |
| laMICTAl | laRGACTil |
| laMISil |
| lamiVUDine  | lamOTRIGine |
| lanTUs | lanVis |
| linCOMYCIN | linEZOLID |
| loSEC | loVAN |
| mercaptAMine (cysteamine) | mercaptOPURine |
| methADONe | methYLPHENIDATe |
| MOXifloxacin | NORfloxacin |
| moBILis | moVALis |
| morphine | HYDROmorphone |
| NEOral  | INDEral  |
| 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 |
| rifaMPICin | rifaXIMin |
| riSPERIDONe | rOPINIROLe |
| siTagliptin | sAXagliptin |
| sUMATRIPTAn |
| Sirolimus | TACrolimus |
| sulfaSALazine | sulfaDiazine |
| toPAMAX | toFRANIL |
| tEGRETOl | tRENTAl |
| tRAMadol | tEMOdal |
| tORadol |
| tAPENTadol |
| trimETHOPRIM  | alimemazine (trimEPRAZINE) |
| valAciclovir | valGANciclovir |
| xalaTAN | xalaCOM |
| zinVit | zinNAt |
| zoCOR | zoTON |
| zoLOFT | zoCOR |

Table 2: Medicines used predominantly in cancer therapy

|  |  |
| --- | --- |
| Medicine name  | LASA medicine name(s) |
| ALKeran | LEUKeran |
| MYLeran |
| avaSTIN | avaXIM |
| ciSplatin | cARBOplatin |
| daCTINomycin | daPTomycin |
| DAUNOrubicin | DOXOrubicin |
| iDArubicin |
| iFOSFamide | CYCLOPHOSPHamide |
| PACLitaxel | DOCEtaxel |
| CABAZitaxel |
| vinBLASTine | vinCRISTine |
| vinORELBine |

Table 3: Classes of medicines

|  |
| --- |
| Cephalosporins |
| cefaLEXin |
| cefALOTIN |
| cefaZOLin |
| cefEPIME |
| cefOTAXIME |
| cefOXITIN |
| ceftAROLine |
| cefTAZIDIME |
| cefTRIAXONE |

|  |
| --- |
| Benzodiazepines |
| cloBAZam |
| CLONazepam |
| DIAzepam |
| LORazepam |
| OXazepam |

|  |
| --- |
| SSRI/SNRI |
| DULoxetine |
| fluoxetine |
| fluVOXAMine |
| PARoxetine |

|  |
| --- |
| Sulfonylureas |
| gliBENCLAMide |
| gliCLAZide |
| gliMEPIRide |
| gliPIZide |

## Specialised medicine names

The following lists of specialised medicines include a prioritised selection of thirty-one LASA medicine names within the MAB (with the suffix ‘mab’) and TKI (with the suffix ‘nib’) classes of immuno-modulating medicines, that have been predicted to pose the greatest risks to patient safety. The list also includes one additional anti-cancer medicine with the ‘gib’ suffix: soNIDEGib.

Table 4: Medicine names with the suffix ‘mab’

|  |  |
| --- | --- |
| Medicine name  | LASA medicine name(s) |
| beNRALizumab | beVACizumab beZLOTOXumab |
| eCULizumab | eFALizumabeMICizumab |
| oBINUTUZumab | oFATUMumab |
| oCRELizumab | oMALizumab |
| pANITUMumab | pERTUZumab |
| raMUCIRumab | raNIBIZumab |

Table 5: Medicine names with the suffix ‘nib’ and ‘gib’

|  |  |
| --- | --- |
| Medicine name  | LASA medicine name(s) |
| aFATinib | aXITinib |
| bARICITinib | biNIMEtinib |
| cABOZANtinib | cOBIMEtinib |
| daBRAFEnib | daSATinib |
| laPAtinib | leNVAtinib |
| pAZOPanib | pONATinib |
| soNIDEGib | soRAFENibsUNITinib |
| tOFACitinib | tRAMEtinib |

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