AUSTRALIAN PATHOLOGY UNITS AND TERMINOLOGY

(APUTS)

STANDARDS and GUIDELINES

(v1.5)

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Therefore, in this edition, the inclusion of “standards” and “guidelines” in each document are provided as an indication of the opinion of the relevant expert authoring group, but should not be regarded as definitive or as widely accepted peer professional opinion. Specifically, these terms do not carry regulatory weight with regard to laboratory accreditation. The use of these standards and guidelines is subject to the health professional’s judgement in each individual case.

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Scope and audience

In scope

This document describes the standards and guidelines developed by the Australian Pathology Units and Terminology Standards (APUTS) Project Group of the Royal College of Pathologists of Australasia.

It provides guidance for implementation of standardised terminology and units.

The document also explains the reasoning behind the work done and is intended to be used as a guide for those working on the development and maintenance of terminology and standardised units across the domains of pathology.

Out of scope

Apart from the terms and units that should be used, this document does NOT deal with the rendering of requests or reports, whether that be for screens or paper.

This document does NOT deal with functional testing such as spirometry, electrocardiography despite the fact that these services are provided by many pathology laboratories in Australia.

This document does NOT specify what is expected in terms of the components of a profile or order set.

This document does NOT deal with the harmonisation of reference ranges.

This document does NOT deal with reference intervals or associated actions.

Note that it should not be interpreted that the issues identified as being out of scope for this document are not important; rather they remain to be addressed or are being dealt with elsewhere.

Audience

The intended audience for the document includes:

- Those involved in pathology terminology and related standards development
- Those looking to understand how decisions were made and consensus achieved.

The intended audience for the reference terminology sets, units and implementation policy, however, is much broader and includes:

- Pathology laboratories
- All consumers of pathology reports and those who request pathology services
- Information systems developers
- Researchers and analysts who use pathology data.

Abbreviations used in this document

APUTS	Australian Pathology Units and Terminology Standardisation
AS4700.2	Australian Standard 4700.2 - See definitions
CDA	Clinical Document Architecture - See definitions
HB262	Handbook 262 – See definitions
HL7	Health Level Seven - See definitions
HUGO	Human Genome Organisation – See definitions
IHTSDO	The International Health Terminology Standards Development Organisation
LOINC	Logical Observation Identifiers Names and Codes – See definitions
NEHTA	National E-Health Transition Authority
PAC	Pathology Associations Council
QUPC	Quality Use of Pathology Committee
RCPA	Royal College of Pathologists of Australasia
SNOMED	Systematized Nomenclature of Medicine – See definitions
UCUM	Unified Code for Units of Measure – See definitions

Definitions

The table below provides definitions for general or technical terms used in this document. Readers should take particular note of the definitions for 'standard', 'guideline' and 'commentary', because these help understand the strength of the statement being made for the numbered items.

AS4700.2	AS4700.2 is the Australian Standard for the Implementation of HL7 for messaging pathology and medical imaging (diagnostics). It was developed by, and is maintained by, Standards Australia's IT-14-6-5 committee. The standard is available at www.e-health.standards.org.au.
CDA	Clinical Document Architecture (CDA) is an HL7 Standard for XML-based mark-up of a document to specify the encoding, structure and semantics of clinical documents for exchange.
Code	A code is a unique concept identifier in a terminology that carries no other meaning.
Commentary	Commentary is text, diagrams or photographs that clarify the standards (see below) and guidelines (see below), provide examples and help with interpretation where necessary (not every standard or guideline has commentary). Commentary is used to: • define the way an item should be reported, to foster reproducibility • explain why an item is included (e.g. how the item assists with clinical management or prognosis of the specific cancer) • cite published evidence in support of the standard or guideline • state any exceptions to a standard or guideline. In this document, commentary is prefixed with 'CS' (for commentary on a standard) or 'CG' (for commentary on a guideline), numbered to be consistent with the relevant standard or guideline, and with sequential alphabetic lettering within each set of commentaries (e.g. CS1.01a, CG2.05b).

General commentary	General commentary is text that is not associated with a specific standard or guideline. It is used to provide a brief introduction to a chapter, if necessary, for items that are not standards or guidelines but are included as items of potential importance for which there is currently insufficient evidence to recommend their inclusion. (Note: in future reviews of Standards and Guidelines, such items may be reclassified as either standards or guidelines, in line with diagnostic and prognostic advances, following evidentiary review).
Guideline	Guidelines are recommendations; they are not mandatory, as indicated by the use of the word 'should'. In this document, guidelines are prefixed with 'G' and numbered consecutively within each chapter (e.g. G1.10).
HB262	HB262 is a handbook published by Standards Australia that gives detailed guidance on how to use AS4700.2. It is available at www.e-health.standards.org.au.
HL7	Health Level Seven is an organisation involved in the development of international healthcare informatics interoperability standards - http://www.hl7.org/.
HL7 v2.x	A set of standards from HL7 for electronic messaging to support clinical practice and the management, delivery and evaluation of health services. The most commonly used set of standards for this purpose in the world, HL7 v2.x messages use a human-readable (ASCII), non-XML encoding syntax based on segments (lines) and one-character delimiters.
HL7 v3 RIM	The Reference Information Model (RIM) is the representation of the HL7 clinical data (domains) and the life cycle of messages or groups of messages which is the foundation of HL7 Version 3. RIM expresses the data content needed in a specific clinical or administrative context and provides an explicit representation of the semantic and lexical connections that exist between the information carried in the fields of HL7 messages.
HUGO	Human Genome Organisation (HUGO), through its Gene Nomenclature Committee (HGNC), approves a unique gene name and symbol (or short-form abbreviation) for each known human gene. All approved gene symbols are stored in the HGNC Database - www.genenames.org.
IHTSDO	The International Health Terminology Standards Development Organisation administers SNOMED - http://www.ihtsdo.org/.
LOINC	Logical Observation Identifiers Names and Codes (LOINC) is a database of terms and standards for identifying medical laboratory observations. It was developed and is maintained by the Regenstrief Institute - http://loinc.org/.

OpenEHR	OpenEHR is an organisation that creates tools and specifications for electronic health records – www.openehr.org.
SNOMED	SNOMED (Systematized Nomenclature of Medicine) is a systematically organised computer processable collection of medical terms providing codes, terms, synonyms and definitions covering diseases, findings, procedures, microorganisms, substances, etc. It is owned and maintained by the IHTSDO. SNOMED CT (Clinical Terminology) is the current form and the Australian variant SNOMED CT-AU is available from NEHTA http://www.nehta.gov.au/connecting-australia/terminology-and-information/clinical-terminology/snomed-ct-au. **Where SNOMED is used in this document it means SNOMED CT-AU**
Standard	Standards are mandatory, as indicated by the use of the term 'must'. In this document, standards are prefixed with 'S' and numbered consecutively within each chapter (e.g. **S1.02**).
Term	Terms are words that in specific contexts are given specific meanings.
Terminology	Terminology is the study of terms and their use. In particular the labeling of concepts particular to one or more subject fields for the purpose of documenting and promoting consistent usage.
UCUM	The Unified Code for Units of Measure is a code system intended to include all units of measures with the purpose of facilitating unambiguous electronic communication of quantities together with their units. The focus is on electronic communication, as opposed to communication between humans - http://unitsofmeasure.org/.
Unit	A unit of measurement is a definite magnitude of a physical quantity, defined and adopted by convention and/or by law, that is used as a standard for measurement of the same physical quantity. Units refer to the system used for this measurement and its representation.

Introduction

Changes in reporting practice

Pathology reporting in Australia (and elsewhere) has evolved through phases where discipline-based departments reporting in isolation then episode-based with results from the whole laboratory reporting with comments pertaining to the patient episode. Now it includes multi-institution reporting where synthesis of results and opinions is often undertaken and conclusions are drawn from previous history and other results, as well as from outside the reporting laboratory.

Exposure of variation and increased risk of error

This evolution in the operations of pathology together with the electronic delivery of reports has led to reports being distributed more widely and reports from different laboratories (and their component results), more often mixed and matched in the course of developing other health records and documents.

Initially this was within institutions but now it is increasingly being used for handover in care and aggregated into records at regional and national level.

Results from the reports are also now frequently used in comparative displays and in computerised decision support in widely different healthcare settings including hospitals, community, indigenous health services and homes.

We know that the errors related to the non-analytical aspects of the pathology process are some of the most important [(1) (2) (3)]. These changes to reporting are likely to increase the risk of misinterpretation and there is anecdotal evidence of this happening and causing harm. This phenomenon is not restricted to Australia and similar circumstances are described elsewhere including in the UK [(4)].

Not only is there variation in the coding and naming of tests but there is also significant variation in the units used for reporting. Again this is also being reported elsewhere [(5)].

All of these changes to practice have exposed the variation that existed but also increased the risk of this variation leading to error in fidelity and/or interpretation. This variation in reporting together with the inappropriate combination of results from different methods has led to serious concerns for clinical safety.

Requirement for standardisation

In Australia most medical practitioners use computers in their day to day practice and most receive their pathology reports electronically, and in some communities and hospitals it is also now routine to request pathology electronically.

Electronic reporting of pathology has been underway in Australia since 1993. In 1998 a consensus-based Australian Standard for the electronic reporting and requesting of pathology (AS4700.2 ([6])) was first published. This is a Standard for the implementation of the global HL7 v2.x healthcare messaging standard in pathology (and diagnostic imaging) in Australia.

AS4700.2 includes recommendations around terminology but in practice there has been significant variation in implementation of both the message format and terminology. This is so despite efforts to improve conformance and compliance by writing a detailed programmer's guide (HB262) (6)), curating and publishing subsets of the referenced terminologies on the web, offering trusted example messages and providing a (free) message testing laboratory (7). Conformity assessment is one of the responsibilities given by Australian health ministers to the National E-Health Transition Authority but this is a very new activity in health and there is little experience here or elsewhere on how to do this effectively and efficiently.

The experience that Australia has had with standardisation of e-health is common internationally. After 20 years of standards development work, there is no universal standardisation of:

- the grammar used to communicate health care information – despite progress with standards like HL7v2.x and CDA
- how to represent information structures – despite progress with models like HL7v3 RIM and OpenEHR
- terminology – despite progress with SNOMED, LOINC, HUGO and many others

Yet many argue that the technology issues have all been resolved and that it is just about getting people to standardise. This is especially true for new entrants to the field. Whenever this standardisation is actually attempted it becomes clear that this is a very rich and complex information domain with significant socio-technical issues that are some way from being mastered. We do not, however, accept that this is proof that it cannot be done, just that it takes time and effort and a lot of knowledge work.

Information structures and terminology

Standardised pathology information structures and terminologies allow improvement in the recording, decision support, communication and analysis of pathology. Being able to communicate in a way that both the sentence (structure) and the words (terms) are understood between computers (semantic interoperability) allows assurance of the fidelity of communication and for information tools like decision support to be provided – all aimed at making it easier and safer to do clinical work.

In routine biochemistry most reporting can be dealt with as a 'question answer pair' such as 'Sodium = 140 mmol/L'. In many disciplines such as microbiology, cancer reporting and genetics, however, information structures are required to provide context for terms. For example, for a microbiology result, the sensitivity to a particular antibiotic class has to be related to one organism that has been cultured (often of a number) and these are grouped with relevant treatment guidelines provided as a comment.

That is to say, terms need context to have meaning and so terminology cannot be developed or assigned without first understanding what it is that has a term bound to it. For example, the term for a diagnosis can mean completely different things if the term is stored in the context of "active problem" or if it is stored in the context of "family history". As natural language uses grammar, context is conveyed by information structures or syntax.

Sets of terms (terminologies) used in context (bound to information structures) are needed for:

- Records - capturing information about a consumer and his/her interactions with the healthcare system
- Decision Support - gaining access to knowledge, helping with workflow and automating processes such as provision of clinical alerts and warnings and for billing
- Communications - allowing more meaningful health information to be exchanged between clinicians and clinical systems within a practice or facility and with others outside the facility including consumers and other health services
- Analysis (including classification of health information) - retrieving and analysing information to improve processes at every level; from care of the individual consumer through to public health and health policy.

A good terminology is (8):

- Appropriate - to the clinical setting (e.g. primary care, hospital, community health, pathology etc.) and for the purpose (e.g. describing diagnosis, test type, allergy etc.)
- Implementable - to work with existing systems and have appropriate systems for standardisation, control, development, maintenance and support
- Understandable - if the terminology is to be used by clinicians and other stakeholders at the point of care users need to be able to use familiar terms. In other words they require an accessible terminology with an appropriate interface language that is relevant to their clinical and discipline needs.
- Acceptable to clinicians - and other stakeholders in terms of searching, relevance and ease of use including navigation
- Acceptable to software developers - by supporting key application functions and decision support
- Acceptable for statistical reporting - and administrative purposes
- Customisable - to meet regional needs and rapid changes in healthcare balanced against the need for shared understanding over time and consistency across settings

A good terminology has the technical characteristics of:

- Content - the terminology must include all the concepts for the meaning people want to convey
- Concept orientation - terms must not be vague, ambiguous or redundant
- Concept permanence - a concept once created is inviolate
- Non-semantic concept identifier - the concept has a unique identifier that carries no other meaning
- Polyhierarchy - there are different ways of arranging the concepts according to use
- Formal definitions - there are definitions by association that computers understand
- No ‘not elsewhere classified’ (NEC) - no catch-all categories as in classifications
- Multiple granularities - it allows for ‘views’ at different levels of detail
- Multiple consistent views - those views must be consistent

- Representation of context - there is formal explicit information about how a concept is used
- Graceful evolution - it allows for the addition and changing of concepts without breaking rules or making structural changes that are not backwards compatible
- Recognition of redundancy - it allows for proper synonyms.

There are two ways of dealing with the development of terms that cover multiple concepts such as is needed for identifying most tests in pathology:

- Having a grammar that allows for the fundamental terms to be put together to make a compound statement – called **post-coordination,** *e.g. sodium-observation+substance-conc+point-in-time+serum+quant+ISE.* The advantage of this choice is that you only need the fundamental terms and you can combine them as needed and match them easily to the specific circumstance. The disadvantage of this approach is that the grammar has to be encoded and meaning implied from the structure. Unless deep knowledge is included, nonsense can be the outcome (like a broken right eyebrow).
- Having a different term for each unique set of combinations of characteristics (concepts) – called **pre-coordination**. The advantage of this is that only one field is needed allowing easy interpretation and manipulation. The disadvantage is that this can lead to a very large number of codes called combinatorial explosion.

  LOINC or the Logical Observation Identifiers Names and Codes (9) is a pre-coordinated terminology now in use in 145 countries for pathology reports and requests. LOINC has six axes to its pre-coordination. For each code (*e.g. 2951-2*) they are:
  - Component (analyte) – *e.g. Sodium*
  - Property measured – *e.g. Substance concentration*
  - Timing – *e.g. A point in time*
  - System – *e.g. Serum (or plasma)*
  - Scale – *e.g. Quantitative (mmol/L)*
  - Method used – *e.g. ISE,* but this is only used where different methods give clinically significant different results.

Units of measure

Most assume that the units of measure used in pathology are already standardised. This is not so. While there have been standards (of sorts) on pathology units in Australia since 1973, with the most recent issued in 1986 (RCPA Broadsheet No. 29) in practice there is significant variation in the units used for some tests and even more widespread variation in how they are rendered on screen and paper and how they are represented in electronic messages.

National plan

As for ‘units of measure’ there have been a number of attempts at standardising the terminology used for the identification of ‘tests’ in requesting and reporting pathology in Australia.

In 2002 a set of Australian Request Codes (called Austpath) was developed and published on the web by the University of Wollongong with funding support from the Commonwealth. This was a set of 2 to 6 character alphanumeric codes for the most commonly requested tests. The codes were established by consensus of the Standards Australia IT-14-6-5 committee using the data from eight large laboratories. Around the same time the group also published a subset of LOINC codes for reporting observations in Australia. LOINC was chosen because existing laboratory information systems, and for that matter, receiving systems, could only deal with single (pre-coordinated) terms and LOINC had by far the greatest uptake internationally.

SNOMED is a comprehensive structured health terminology that had its origins with the College of American Pathologists but is now owned and maintained by the International Health Terminology Standards Development Organisation (IHTSDO). Australia was a founding member of the IHTSDO through the newly formed Australian National E-Health Transition Authority (NEHTA). Use of SNOMED for pathology was part of the business case for Australia to join the IHTSDO. Despite its origins SNOMED does not have good coverage of pathology observables. There is now work underway to have LOINC incorporated into SNOMED.

In 2007 NEHTA produced pathology terminology using SNOMED and information structures. A review of the NEHTA pathology 'data groups' and terminology found them wanting and they were not adopted. In 2010, NEHTA changed its engagement with Standards Australia and as part of that there was an initiative to align the work programs. A joint plan was developed in a workshop. Invited to the workshop were members of the Pathology Associations Council (including RCPA, the Australian Association of Pathology Practices and scientific societies) Standards Australia and related NEHTA sections. The outcome of that meeting was a National Pathology Terminology and Information Standardisation Plan shown below. The plan was subsequently formally supported by NEHTA, Standards Australia Committee IT-14-6-5, the RCPA e-Health Taskforce and the Pathology Associations Council.

National Pathology Terminology and Information Standardisation Plan (2011)

Stakeholders

Leaders

Pathology profession

Through RCPA and other PAC members; Provides primary link to the care team; Defines and endorses terminology content, esp. clinical terminology

Standards Australia

Primary link to ISO standards development and, pathology system developers and end users; Approves and publishes Australian Standards

NEHTA NCTIS

Primary link to clinical informatics community; Develops, maintains and distributes clinical information and terminology standards

Customers

By type

Healthcare consumers; Clinicians and others associated with healthcare providers (each with different models of care and represented by colleges, professional and industry associations); Researchers; Health software developers and knowledge resource developers; Statistical users

By activity

Local Terminology & Information Integrators - including organisations that develop local domain terminologies or classification code sets and, also, health systems developers and systems integrators including Jurisdictional e-Health programmes.

Clinical Terminology Users - who use systems supplied by a local terminology and information integrator or, alternatively, take and deploy Australian domain terminology or structured information in their own systems.

Collaborators

- Clinical Colleges, Associations and Scientific Societies (RCPA, AACB, AAPP, AIMS, ANZSBT, ASCIA, ASC, ASM, ESA, HSANZ, HGSA, HISA, IAP, NCOPP)
- Standards developers (IHTSDO, NEHTA, HL7 Australia, Standards Australia IT-14-6-5, NCCC)
- HI Professional and industry associations (HISA, HIMAA, MSIA, AIIA)
- Academia (Universities and Research Centres)
- Government agencies and authorities; ACSQHC, AIHW, Cancer Australia, Health Departments, Registries
- Jurisdictional E-Health Programs

Funders

- DoHA QUPP
- IT-14-6-5 (wrt Australian standards approval only)
- NEHTA (wrt Board approved workplan only)

Vision, Aims, and Principles

Vision

Australia has access to and uses standardised pathology information structures and terminologies to optimise systems for recording, decision support, communication and analysis so as to improve healthcare for the individual; the population; and the healthcare system for its practitioners and payers.

Aims

- To set up a system to develop, maintain and distribute Detailed Clinical Models (terminology and information structures) for Australian pathology domain content;
- To develop specific guidance for the binding of terminology to information structures to support system to system messaging;
- To develop terminology and information content by sub-disciplines in the pathology domain;
- To identify and/or develop a standard for the coded representation of units of measure in the pathology domain;
- To establish a 'one stop shop' for the development, maintenance and distribution of all terminology content necessary to support the pathology domain;
- To collectively drive the adoption of the Detailed Clinical Models for the pathology domain;
- To establish a workable compliance, conformance and accreditation environment relating to pathology domain information structures and terminologies.

Principles

- That the terminology used for pathology reporting and requesting should be standardised
- That a combination of terminology products will be required to deliver the necessary standardisation (which is likely to include elements from within SNOMED CT, LOINC, HL7 vocabulary tables and MeSH)
- That terminology development, maintenance and distribution is recognised as a specialist activity overseen by the NCTIS as a dedicated unit using a consistent set of tools and processes
- That the 'traditional knowledge owners' within the pathology domain be responsible for defining what the content of the standardised content shall be.

Key Result Areas

Content Development

- Fit for purpose terminologies have been developed and approved by the Pathology Profession, Standards Australia IT-14-6-5 and NEHTA's NCTIS.
- *KPIs –Quality (rework); Completeness (rate of change); Timeliness(%milestones reached)*

Content Distribution

- A system that facilitates consistent, simple distribution and updates of pathology terminologies is in use
- *KPIs – Consistency (incident monitoring); Simplicity (implementer feedback); Update (compliance statements).*

Adoption

- Adoption of standardised information structures and terminology is widespread across the pathology domain;
- There is direct realisation of benefits from standardised terminology use
- *KPIs- Adoption (% vendor adoption; % transaction volume); Benefit realisation (Decrease in rate of receiving system rejection of received messages due to code non-recognition)*

Compliance, Conformance and Accreditation

- An implementable compliance, conformance and accreditation environment is in place to assure the correct use of pathology information and terminology components;
- *KPIs – Implementable (proof of concept implementation with >1 pathology system vendor and >1 clinical end user system vendor); Correct use (% of conformant messages)*

Projects

1 Governance, Planning and Resourcing

- Establish the principles of governance for the development, maintenance and distribution of pathology terminology in Australia. Develop this plan, a governance structure to implement it and put in place project plans and resources

2 International approaches to path terminology use

- Review international approaches to pathology terminology use across key e-Health implementing nations

3 Terminology Binding for AS4700.2

- Develop specific guidance for binding terminology to the HL7 2.4 message required by AS4700.2 and update HB 262 to harmonize with the NEHTA NCTIS terminology and information specifications, the IHE profile and AS4700.2

4 Standard for Units of Measure

- Develop and approve a revised set of coded standard units of measure to update and future proof RCPA / AS4700.2

5 Australian Pathology Terminology Sets

- Develop, approve and distribute standard terminology sets (SNOMED CT, LOINC etc.) to populate AS4700.2 coded data

6 Standardisation of common biochemistry items

- Develop a fully specified terminology for the reporting of 'common' biochemistry items used in clinical decision support;

7 Terminology for structured cancer reports

- Review the protocols for cancer reporting and ensure terminology is available, consistent and able to be used in electronic decision support;

8 Terminology for QA programs

- Develop standardised terminologies to be used with standardised messages for the reporting of routine pathology quality assurance testing

9 NPAAC data standard review for terminology

- Revise existing NPAAC Requirements for Information Communication to address terminology;

Endorsed jointly by NEHTA and Standard Australia IT-14-6-5 V1.3– Nov 10

PUTS Project

The National Plan included the allocation of project leadership. The projects that were identified as being led by the profession were included in an application for support prepared by the RCPA and submitted to the Quality Use of Pathology Program in November 2010. It was endorsed by QUPC and funded by the Department of Health and Ageing.

Projects 4-7, the profession led projects, became the RCPA Pathology Units and Standardisation Project, namely:

- **Standard for units of measure** which aims to develop a revised standard for the use of units in pathology indicating preferred units for display and a mechanism for their representation in electronic messaging.
- **Australian pathology terminology sets** which aims to develop sub-sets (or reference sets) of pathology terminology for requesting and reporting pathology by discipline
- **Standardisation of report terminology for common biochemistry items** which aims to develop fully specified terminology for the reporting of common chemistry items used in decision support
- ***Terminology for structured cancer reporting*** which aims to review the protocols for structured cancer reporting and ensure terminology is available, consistent and ultimately able to be used in electronic decision support.

Design of this document

This document contains 'Standards' and 'Guidelines' for both the development and implementation of the Australian terminology reference sets and standardised units. These are indicated by the headings 'Development' and 'Implementation'.

Elements intended to become mandatory (standards) are differentiated from those that are not mandatory but are recommended (guidelines). *Italics* are used for examples.

Changes since the last edition

First public release after public comment and Council approval

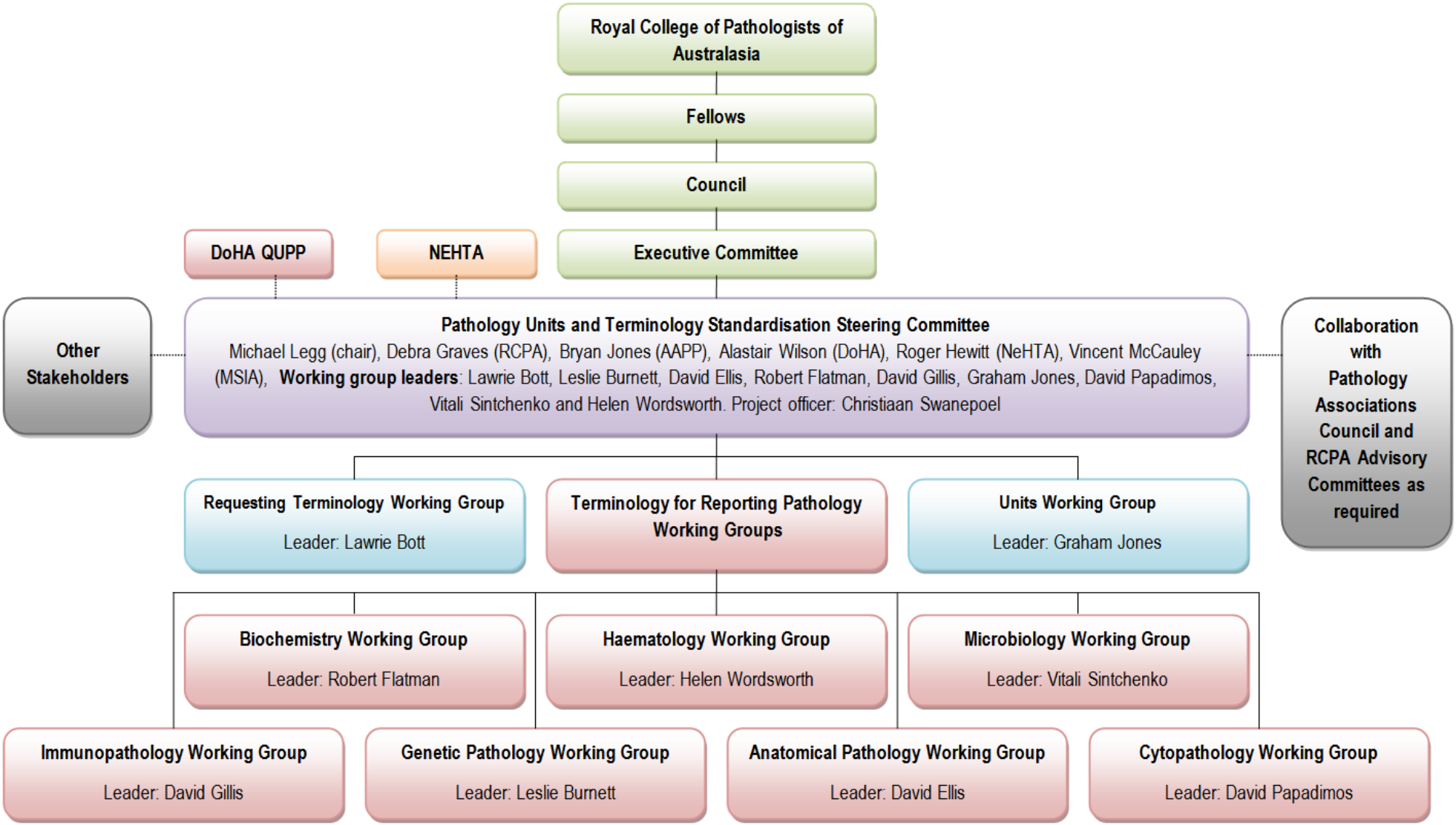
Authority and development

All of the authorised outputs from the APUTS project were subject to the governance described in the diagram below. This approach and governance structure is modelled on that used successfully by the RCPA for the development of protocols for reporting the laboratory findings associated with cancers.

While all member organisations of the Pathology Associations Council were stakeholders in developing consensus for these standards the ultimate authority for this document rests with the Council of the Royal College of Pathologists of Australasia.

The initial work for this standard and its associated documents was developed by some 80 pathologists, other clinicians, scientists and informaticians as part of the RCPA Pathology Units and Standardisation Project from April 2011 to November 2012. A similar process to that used by Standards Australia for the development of consensus standards was used here. More detail is provided in the 'Development process' section below.

Membership of the Steering Committee and the working groups is provided at Appendix 1 - Members of Working Groups**.**


Royal College of Pathologists of Australasia
Fellows
Council
Executive Committee
DoHA QUPP
NEHTA
Other Stakeholders
Pathology Units and Terminology Standardisation Steering Committee
Michael Legg (chair), Debra Graves (RCPA), Bryan Jones (AAPP), Alastair Wilson (DoHA), Roger Hewitt (NeHTA), Vincent McCauley (MSIA), Working group leaders: Lawrie Bott, Leslie Burnett, David Ellis, Robert Flatman, David Gillis, Graham Jones, David Papadimos, Vitali Sintchenko and Helen Wordsworth. Project officer: Christiaan Swanepoel
Collaboration with Pathology Associations Council and RCPA Advisory Committees as required
Requesting Terminology Working Group
Leader: Lawrie Bott
Terminology for Reporting Pathology Working Groups
Units Working Group
Leader: Graham Jones
Biochemistry Working Group
Leader: Robert Flatman
Haematology Working Group
Leader: Helen Wordsworth
Microbiology Working Group
Leader: Vitali Sintchenko
Immunopathology Working Group
Leader: David Gillis
Genetic Pathology Working Group
Leader: Leslie Burnett
Anatomical Pathology Working Group
Leader: David Ellis
Cytopathology Working Group
Leader: David Papadimos

Standard developers

This standard was developed by expert committees, with assistance from relevant stakeholders. It draws on SNOMED owned by the International Health Terminology Standards Development Organisation and LOINC owned by Regenstrief Institute under their respective license terms. The license terms for SNOMED are provided at https://nehta.org.au/aht/index.php?option=com_content&task=view&id=5&Itemid=35; and for LOINC at http://loinc.org/terms-of-use.

Expert committee

The expert committee responsible for this document was the Pathology Units and Terminology Standardisation Steering Committee. Members of the Committee and its Working Groups are listed in Appendix 1 - Members of Working Groups

International liaison

Australia is an active participant in international activities toward the harmonisation of standards for pathology. In particular the UK National Health Service has for some years been working on a single national catalogue, the National Laboratory Medicine Catalogue (NLMC) for the electronic requesting, laboratory processing and report generation of pathology tests for use within the National Health Service. While the actual terminology used in England has not been adopted, in the interests of harmonisation we have attempted to align the rules here with those of the UK where this is practical. Similarly, this approach has been adopted with LOINC and SNOMED terminology rules.

Acknowledgements

The Pathology Units and Terminology Standardisation Steering Committee wishes to thank all the pathologists, other clinicians, scientists and informaticians who contributed to the discussion around this document. In particular, we acknowledge the active and diligent contributions of the Working Group Members.

The initial project had funding for its administration provided by the Australian Department of Health and Ageing. The time and effort of the members, however, was provided on a voluntary basis and this contribution by individuals and their employers is both recognised and appreciated.

Stakeholders

The pathology profession was represented through the Royal College of Pathologists of Australasia (RCPA) and other members of the Pathology Associations Council (PAC) www.pathology.med.pro.

The pathology profession defines and endorses the clinical terminology to be used for pathology in Australia with regard to the customers and colleagues of medical laboratories. The National Clinical Terminology and Information Service (NCTIS) within the National E-Health Transition Authority (NEHTA) is responsible for managing, developing and distributing SNOMED CT-AU in Australia and is expected to publish other terminologies for pathology in due course. The Standards Australia Committee IT-014, and in particular its working group for diagnostics

IT-14-6-5, provides the main link to Australian and international health informatics standards development, software developers and users. The Medical Software Industry Association provides a representative connection to the commercial developers of medical information systems.

Other relevant stakeholders are identified in the National Plan above.

Secretariat

Professor Michael Legg PhD FFSc(RCPA) FAICD FAIM FACHI acted as the Project Manager and Dr Christiaan Swanepoel MBChB MMedChemPath the Senior Project Officer for the APUTS project.

Development process

Where no reference is provided, the authority is the consensus of the expert group.

The initial work for this standard and its associated documents was developed by some 80 pathologists, other clinicians, scientists and informaticians as part of the RCPA Pathology Units and Standardisation Project from April 2011 to November 2012. There were 8 working groups covering each of the pathology disciplines. The working groups were:

- Units
- Terminology used for requesting pathology
- Terminology used for reporting pathology in reports:
    - Anatomical and cytopathology
    - Biochemistry
    - Genetic pathology
    - Haematology
    - Immunopathology
    - Microbiology

Working groups met fortnightly by phone and had a number of face-to-face meetings with the outcomes distributed to members between meetings for review.

Comment on committee drafts was sought from interested organisations identified by each of the working groups. In addition all other working group members were requested to review the material and a public notice was posted inviting comments.

All comments were considered and resolved by the respective working groups. The activity and process was promoted through conferences and membership activities of the stakeholder organisations with invitation for participation either as active members or corresponding members of the working group.

1 Terminology

The chapters that follow describe standards and guidelines that apply to preferred terms for the names of tests for both requesting and reporting pathology in Australia.

These are the rules that have been applied by the PUTS Project Working Groups in developing the reference sets of Australian pathology terminology and the associated preferred terms.

Guiding principles

1. The standardisation of pathology terminology and units in Australia is desirable and achievable.
2. No single existing terminology will be sufficient.
3. Having well-developed subsets of terms will improve conformance, compliance and efficiency.
4. A high level of knowledge and familiarity with the practice of pathology is required to develop and maintain these subsets.
5. The terms used in Australia should reflect common usage but be consistent and safe.
6. The terms should also be practical and capable of ready implementation.
7. All pathology terminology and associated units should be available in one place.
8. SNOMED is to be used as the preferred terminology for requesting pathology.
9. LOINC is to be used as the preferred terminology for the highest level test name in reporting pathology.
10. A rendering of the pathology report as the issuing laboratory intends it to be read, must be sent by the laboratory in all electronic messages. Receiving systems should be able to conveniently display this rendering to the reader for review if it is not used as the primary form for display.
11. Combining data for a subject from what appears to be the same test in a time series such as in cumulative reports or graphs, carries with it significant clinical risk of misinterpretation and should only be done after that risk has been properly assessed.
12. This same variation in results means caution is required when grouping results from different laboratories, methods or times for research or other statistical purposes.

2 Requesting terminology and codes

A set of terms for requesting pathology in Australia and their associated codes is available at www.rcpa.edu.au/Library/Practising-Pathology/PTIS/APUTS-Downloads. This set comprises the most commonly requested terms used in both public and private practice.

Implementation

S2.01 Where a code is used to identify a concept from the APUTS Request Set for electronic communications it must be the code that appears associated with the term in the reference set.

CS2.01 Where no such term or code is available a local code may be used provided it is identified as such in the message.

G2.01 Electronic requests for pathology testing in Australia should use coded test concepts and preferred terms from the set referenced here (the APUTS Request Set).

CG2.01 Where no appropriate term is available free text may be used to describe the test.

G2.02 Where possible, requests should include the clinical question being asked.

Development

S2.02 Codes for terms used to request pathology tests in Australia must come from SNOMED.

CS2.02 Where no code is available, a request for a new code should be made. A temporary code will then be issued and that should be used in the interim.

G2.03 If the specimen is not explicitly specified then blood/serum/plasma is the assumed specimen type unless there is a more common specimen for the particular test.

G2.04 Attributes such as the anatomical site or clinical condition should only be included in request test names where it is common practice to request in this manner.

CS2.02 Where a specimen type is specified it should follow the substance identifier in abbreviated form.

3 Reporting terminology and codes

A set of terms for reporting pathology in Australia and their associated codes and preferred units is available at www.rcpa.edu.au/Library/Practising-Pathology/PTIS/APUTS-Downloads

The **reference terminology sets** for a result name (the question) developed and maintained by experts for each of the disciplines is available:

- Anatomical and cytopathology
- Chemical pathology
- Genetic pathology
- Haematology
- Immunopathology
- Microbiology

The context for the use of result name terms (the questions) where the result reported is not a simple question-answer construct is described in **information models** which are available.

- Anatomical and cytopathology
- Chemical pathology
- Genetic pathology
- Haematology
- Immunopathology
- Microbiology

In some cases the expert committees have also produced reference sets for **terms used in results** (the answers to the questions, for example terms and codes for pathogens) and these are available at www.rcpa.edu.au/Library/Practising-Pathology/PTIS/APUTS-Downloads

- Anatomical and cytopathology
- Chemical pathology
- Genetic pathology
- Haematology
- Immunopathology
- Microbiology

Implementation

S3.01 Where a code is used to identify a term from the APUTS Report Set for electronic communications it must be the code that appears associated with the term in the reference set.

CS3.01a Where no such term or code is available a local code may be used providing it is identified as such in the message.

CS3.01b Where no code is available a request for a new code should be made. A temporary code will be issued and that should be used in the interim.

G3.01 Electronic pathology reports should use information models, coded test name concepts and preferred terms from the materials referenced here (the APUTS Report Set).

CG3.01 Where no appropriate term is available free text may be used to describe the test.

Development

S3.02 Codes for terms used to report pathology tests at the highest level (the first question) in Australia must come from LOINC.

G3.02 Codes for terms used to report the answers to pathology tests should, wherever possible, come from well maintained and recognised international terminologies. SNOMED should be the first choice and used where it is adequate.

4 Tests not to be combined in reports

There are some tests for which it is inappropriate and unsafe to compare results between laboratories and/or over time. The reasons for this include different methods, changes to reagents for the same method and/or different clinical conditions.

The combination status of tests, i.e. an indicator of whether they may be combined, must not be combined, or are under review is available separately at www.rcpa.edu.au/Library/Practising-Pathology/PTIS/APUTS-Downloads

Implementation

S4.01 Tests that have method-dependent terms and codes in the APUTS report terminology reference sets must have the appropriate term and code applied.

S4.02 Tests that have different codes must not be shown as the same test in sequential display whether by graph or cumulative reporting.

5 Preferred terms

Preferred term is the term preferred for use for the test in Australia for display on paper reports or screens. The test is fully described by the corresponding fully defined name from either SNOMED (for requesting) or LOINC (for reporting).

The rules for establishing preferred terms apply for requesting and reporting. Many of the rules are aimed at ensuring safe rendering of the names by various devices and in different circumstances. As an example, the use of special characters such as Greek letters, symbols, super and subscripts that may not be able to be rendered by some devices can lead to misinterpretation and so are ruled against. There is also a general aim to remove redundancy and make the most important element of a name come first.

Implementation

C5.01 Guideline G3.01 applies

G5.01 Where there is no preferred term available for a test here, free text descriptions should conform to the conventions used in developing preferred terms as described here.

Development

S5.01 The length of preferred terms must not exceed 40 characters.

CS5.01 There are report formats for which 40 characters is too large. For routine tests, names should use a maximum length of 20 characters. The label used in columnar cumulative reports should use a maximum length of 13 characters.

S5.02 The identifier of the substance being measured must come first *e.g. Hepatitis A Ab* not *Antibodies, Hepatitis*.

S5.03 Modifying words must follow the noun in the test name unless overridden by common usage *e.g. Calcium Urine.*

S5.04 Australian English spellings must be used for terms. The Macquarie Dictionary should be used as the reference to current practice in Australia where the term does not appear in the lists referenced here *e.g. faecal* not *fecal* and *haemoglobin* not *hemoglobin.*

S5.05 Abbreviations including acronyms used in developing preferred terms must come from the list in Appendix 3 – Approved abbreviations

CS5.04a If the same words or terms used in different test names are sometimes abbreviated the unpredictability will make it more difficult to find the desired name when searching. For example: the approved abbreviation of the word *antibody* to *Ab* for use throughout immunology means that the word *antibody* should not appear by itself in any immunology test request display names.

CS5.05b Acronyms may be used for test names but only if they are well established in common use and there is little risk of confusion *e.g. FBC for Full blood count*. Consideration, however, should be given for inclusion as an alternative name (synonym) rather than as the preferred term.

S5.06 Capital letters must only be used for:

- The beginning of a test name
- If a test name is a profile and contains more than one test each test will start with a capital letter *e.g Electrolytes Urea Creatinine*
- Eponyms where capitalisation is proper *e.g. Bence Jones protein*
- Acronyms following accepted scientific usage *e.g. IgG* for Immunoglobulin G not *IGG* ; and *DNA* for deoxyribonucleic acid not *dna*

S5.07 Full stops must not be used to end test names.

S5.08 Apostrophes must be used only where it is grammatically correct to do so.

S5.09 Commas must not be used within the test name except within a chemical structure *e.g. 2,3-diphosphoglycerate.*

S5.10 The forward slash symbol / must be used for ratios in test names not the colon : *e.g. Calcium/Creatinine.*

CS5.10 A colon may be used in a test name where it is a formal part of the test name *e.g vWF Ag:Ristocetin cofactor.*

S5.11 Prefixes and numeric ranges must be hyphenated except where the common use of a word would make hyphenation irregular *e.g. Non-motile sperm count* or *17-Hydroxyprogesterone* or *Alpha-1-anti-trypsin.*

S5.12 – Greek symbols must be shown as their equivalent roman character if not spelt out *e.g. Alpha-fetoprotein*, *5-a-dihydrotesterone level*, *b-human chorionic gonadotropin.*

CS5.12 In some cases the abbreviation may hinder searching if a

commonly used name is altered, e.g. *Alphafetoprotein (AFP)* versus *a-fetoprotein level (AFP)*. Such considerations should be assessed before applying this guideline

S5.13 Subscripts and superscripts must not be used in test names.

S5.14 Brand names must not be used.

CS5.14a Brand names where they are common can be used as a synonym. For example: *Clinistix* is a common branded Point of Care Test (POCT) method for measuring the glucose level in urine but it should not be used in the test name.

CS5.14b The generic name of a drug should be used not the brand name when referring to drug concentrations and antimicrobial susceptibilities *e.g. Propranolol*, not *Inderal* (Brand or trade names can be used as synonyms).

S5.15 For immunology it must be specified whether it is antigen or antibody using the abbreviation *Ab* and *Ag* respectively (provided it is known).

CS5.15 For requesting this may not be known in which case *serology* should be used.

G5.02 Numbers should be used according to common usage *e.g. 17-Hydroxyprogesterone* or *Factor V.*

G5.03 The percentage symbol should be used as appropriate *e.g. O2 saturation % in arterial blood.*

G5.04 Prepositions such as *with* should be used only where essential. Shorthand abbreviations should not be used *e.g. with* not *w/.*

G5.05 Logical conjunctions such as *and* should be used as appropriate but not + or *&.*

G5.06 Unnecessary qualifiers should not be used. As an example, the use of the word *total* is often redundant and should not be used except where it is required as an explicit distinction from a measured level e*.g. Cholesterol* not *Total cholesterol level.*

G5.07 The use of generic terms for classes of compounds should not be used when they do not accurately represent the thing being measured *e.g. Ethanol* not *alcohol level* and *Glucose* not *blood sugar level.*

G5.08 Chemical symbols and chemical shorthand should not be used. Common best practice use should be the norm *e.g. Ethanol level* not *EtOH level; Sodium* not *Na; Vitamin D2* not *(1S)-3-[2-[(1R,3aR,7aS)-1-[(2S,5R)-5,6-dimethylhept-3-en-2-yl]-7a-methyl-2,3,3a,5,6,7-*

hexahydro-1H-inden-4 -ylidene]ethylidene]-4-methylidene-cyclohexan-1-ol.

G5.09 The anionic name for chemicals should be used not the acid name *e.g. lactate, citrate,* and *urate*, not *lactic acid, citric acid* or *uric acid.*

G5.10 Single-word names for alcohols should be used *e.g. methanol, ethanol* and not *methyl alcohol* or *ethyl alcohol.*

G5.11 OH should be spelt out as *Hydroxy* with no space or hyphen between Hydroxy and the next word *e.g. 17-Hydroxyprogesterone.*

G5.12 The noun form of the target of the antibody should be used *e.g. Myocardium Ab*, not *Myocardial Ab or Meningococcus Ab*, not *Meningococcal Ab.* (Other forms, however, may be used as synonyms.)

G5.13 The word *anti* should not be used routinely for naming antibodies *e.g. Cardiolipin Ab* not *Anti-cardiolipin antibody*.

CG5.13a Because of common usage there are exceptions to this rule however, and they are: *Antinuclear Ab* and *Anti D Quantitative Assay.*

CG5.13b *Anti* should, however, be used for inhibitory activity *e.g. anti Xa.*

G5.14 The full taxonomic name of an organism (virus, bacterium or parasite) should be used not the disease when describing a test that diagnoses that disease *e.g. Rickettsia rickettsii Ab* not *Rocky Mountain spotted fever Ab; Herpes simplex virus Ab* not *HSV Ab (t*he disease name should be included as a synonym).

G5.15 For species, *sp* (italicised) should be used to identify a single species whose identity is not known. For groups of species *spp* (italicised) should be used to identify the set of species beneath a genus. In some tests, antibodies apply to different strains of species. In rickettsial diseases, the antibodies are against groups of species like the spotted fever group or the typhus group *e.g. Rickettsia spotted fever group* and *Rickettsia typhus group.*

G5.16

– When tests include the name of a bacterium the full bacterial name from the Prokaryotic Names with Standing in the Nomenclature (http://www.bacterio.cict.fr/index.html) should be used *e.g. Neisseria gonorrhoeae DNA.*

G5.17 When tests include the name of a virus the viral name as given by International Classification on the Taxonomy of Viruses (www.*ictvdb.org/)* should be used *e.g. West Nile virus IgM Ab.*

6 Units of measure

The preferred units of measure which are to be used in Australia are available by test at www.rcpa.edu.au/Library/Practising-Pathology/PTIS/APUTS-Downloads**.**

Common Australian Units of Measure with their UCUM representation and standard display form are shown in Table 1.

Background

Most assume that the units of measure used in pathology are already standardised. This is not so. While there have been standards (of sorts) on pathology units in Australia since 1973, with the most recent issued in 1986 (RCPA Broadsheet 29), in practice there is significant variation in the units used for some tests and even more widespread variation in how they are rendered on screen and paper and how they are represented in electronic messages.

As an example of this variation, the following units were taken from reports for Creatinine Clearance from around the same time

- mL/sec
- mL/min
- mL/min/1.7m2
- mL/s.

In terms of its culture, Australia sits somewhere between Europe and the Americas. This influences the customs and standards that are adopted. For pathology units of measure this has led to Australia using a hybrid of common practices from both regions e.g. substance concentration (*mmol/L*) and mass units (*mg/L*) and sometimes its own conventions. Even where there seems to be agreement on the system of units of measure that will be used, the way that it is rendered varies. Take this real-world list of reported units for 24 hour urine potassium determination

- mmol/day
- mmol/d
- mmol/24 hrs
- mmol/24hrs
- mmol/24hr
- mmol/24h
- mmol/24 hour.

While unlikely to be misinterpreted by human readers this cannot be easily interpreted by computers. To address this issue, the **Unified Code for Units of Measure (UCUM)** has been devised by the Regenstrief Institute. The UCUM system gives just one logical, unambiguous way of describing the units. For the example above, the UCUM representation would be mmol/(24.h).

In determining the preferred unit of measure for a concentration there are typically three choices to make, namely:

- the type of unit for the numerator (quantity e.g. grams vs. statement of amount - moles)
- the multiplier (e.g. milli or micro)
- the denominator (e.g. litre). The volume litre is preferred although there are exceptions in common use.

If all these factors indicate the same unit for a specific test the selection is easy. If there is significant disagreement for units for a test between the different sources above there needs to be a selection taking the entirety into account. The overriding principle should be one of patient safety. This can play out by aiming to reduce the number of laboratories needing to change units, aligning reporting units with common reference sources or selecting units to facilitate calculations.

Guiding principles

1. The standardisation of units used for reporting pathology in Australia is desirable and achievable.
2. All pathology terminology and associated units should be available in one place.
3. A single, test-specific, standardised unit of measure is preferred for use in reports from pathology laboratories.
4. Units should be represented in electronic messages in such a way that receiving systems can readily convert units under the clinical governance of the receivers.
5. The Unified Code for Units of Measure (UCUM) is to be used as the logical representation of units of measure in electronic messages (to allow for principle 4).
6. Numeric results should always have the appropriate units associated with them and they should never be displayed without them.

Implementation

G6.01 Units of measure should always be shown where a quantity is shown on pathology reports.

CG6.01 The exception is where it is explicit that no units are used for a particular test such as *Human chorionic gonadotropin qual*.

G6.02 Pathology reports should use the units specified in this document for those tests where units have been determined.

G6.03 A single, standardised unit of measure should be used for tests in reports from pathology laboratories.

CG6.03 There may, however, be valid exceptions to this rule;

- in a transition from one preferred unit to another
- where alternate units are required by legislation or regulation such as for a registry
- during a period of consensus building as to which will be the preferred unit, but this period should be a short as is practical
- where a facsimile of an historic report is produced – historic data need not comply.

G6.04 Units should be represented in electronic messages in fields for units in such a way that receiving systems can readily convert units under the clinical governance of the receivers. The Unified Code for Units of Measure (UCUM) must be used where it is the intention to represent units in a computable form (see http://unitsofmeasure.org/).

G6.05 Where the unit is not specified here, UCUM should be used for the unit. UCUM lexical elements such as square brackets ('[' and ']') can be removed in the display format for enhanced clarity. However, the fully defined UCUM syntax should be used in electronic messaging.

G6.06 Superscripts and subscripts should not be used in units.

G6.07 The carat symbol (^) should not be used to represent "raised to a power of" as this symbol is used as a component separator in HL7 messages.

Units raised to a power should be indicated in the preferred display unit by the exponent as an integer number written immediately behind the unit term. For example, the preferred display unit for millilitre per minute per 1.73 square metre is *mL/min/1.73m2.*

Powers of ten should be represented by *10* e.g. 10*12/L* not *10^12/L* for red cell count.

Development

The following criteria should be used to determine the preferred unit of measure for a test

G6.08 Common usage in Australia should be considered. If a test is already reported either entirely, or nearly entirely in a unit type by Australian laboratories, this unit should be preferred.

G6.09 Previous Australian guidelines specifying a unit type should be considered. In practice this kind of recommendation is usually limited to the College Broadsheet 29 from 1986 on the introduction of SI. There are a number of other specific recommendations endorsed by the College and other organisations. For example, serum creatinine in umol/L and GFR in mL/min are such specific recommendations. The effectiveness of previous recommendations can be assessed by reviewing common usage.

G6.10 Use of units in Australian clinical guidelines should be considered. If a unit is commonly used in clinical guidelines and other reference material in Australia then this favours the use of this unit. Examples would be the use of mmol/L for serum total, LDL and HDL cholesterol and mmol/L for serum glucose. It should be noted that these may change over time, e.g. the introduction of mmol/mol for HbA1c.

G6.11 The implementation of the International System of Units (Système International d'Unités, SI) should be considered. Units conforming with SI should be selected on the basis of our agreed national measurement system. Note that there are currently specific exceptions to this in laboratory medicine that have full agreement. Examples are mL/min for glomerular filtration rate rather than mL/sec, and U/L for enzyme activity rather than the SI unit, the katal.

G6.12 Units used for related tests should be considered. For example, reporting both total protein and albumin in g/L makes calculation and understanding of globulin results easier. Using the same units in serum and urine facilitates some calculations such as clearance. In general it would be preferred that similar tests are reported in the same units (e.g. all lipids in mmol/L; all drugs in mass units) although exceptions may be required.

G6.13 Common usage in other countries should be considered. Specifically, English speaking countries where reference documents and supporting information may be sourced.

G6.14 Use of units in international guidelines and reference sources should be considered. For example, if the clinical oncology guidelines from American Society of Clinical Oncology in the USA use a specific unit for a tumour marker, this may be influential with regard to local use.

G6.15 Units used to define reference standards should be considered. If the primary reference standard for an analyte is defined in a units type (e.g. International Units (IU) for hCG), this is supportive of using this unit for reporting test results.

G6.16 Units for clock time should not be used. Use of time without a date should be discouraged.

G6.17 Test names should include relevant information to prevent the use of annotations in units. Additional information could appear elsewhere such as on the report or in online manuals. For example, the unit for the Albumin/creatinine ratio is *mg/mmol*. It is clear from the test name that albumin is reported as a ratio to creatinine. Annotating the unit with creatinine is therefore unnecessary (i.e. milligrams per millimole of creatinine). Ratios should be reported in the same units as the components of the ratio. For example, the unit for the Albumin/creatinine ratio is *mg/mmol* rather than simplified as *g/mol.*

G6.18 Arbitrary units should be represented by *U* in the preferred display instead of *Arb'U*. For example *U/mL* (UCUM: *[arb'U]/mL*). Note it is important to transmit the correctly mapped UCUM unit in electronic messages to differentiate arbitrary units from enzyme units, which is also represented by *U*.

Arbitrary units will replace dedicated units unless there is a PUTS working group recommendation to keep a specific unit such as the *Bethesda unit*. For example, use arbitrary units (*U*) instead of GPL units (UCUM: *[GPL'U]*) for the biologic activity of Cardiolipin IgG Ab.

Use Bethesda Units with preferred display format *Bethesda U* for Factor VIII Inhibitor (UCUM: *[beth'U]*).

Catalytic activity or enzyme units should be represented by *U* in the preferred display (UCUM: *U*). Note that *U* is also used as the preferred display for arbitrary units.

- International units is a type of arbitrary unit and is represented as *IU* in the preferred display format (UCUM: *[IU]*).

G6.19 *Per 24 hours* should be used instead of *per day* for daily excretion rates represented as */24h* and not according to the UCUM syntax as */(24.h)*. However, the fully defined UCUM syntax should be used in electronic messaging.

G6.20 Year should be represented with *year* and not UCUM: *a*. For example, the preferred display unit of "per year" will be */year* not */a.*

G6.21 Ratios should have no preferred display unit. For example, INR or Free Kappa/Lambda ratios.

G6.22 For Haematocrit, Litre/Litre or else no unit should be used (L/L is endorsed by UK Pathology Harmony).

G6.23 For pH no unit should be displayed (also endorsed by UK Pathology Harmony), but the fully defined UCUM syntax *[pH]* should be used in electronic messaging.

Table 1 - Preferred Units

Description	Preferred Display	UCUM Unit
arbitrary unit	U	[arb'U]
arbitrary unit per millilitre	U/mL	[arb'U]/mL
Area under curve	mg.h/L	mg.h/L
Bethesda unit	Bethesda U	[beth'U]
billion per litre	10*9/L	10*9/L
centimetre	cm	cm
copies per millilitre	copies/mL	{copies}/mL
day	d	d
degree Celsius	Cel	Cel
enzyme unit per 24 hour	U/24h	U/(24.h)
enzyme unit per gram	U/g	U/g
enzyme unit per litre	U/L	U/L
enzyme unit per millilitre	U/mL	U/mL
enzyme unit per millimole	U/mmol	U/mmol
Femtolitre	fL	fL
femtomole per litre	fmol/L	fmol/L
globules (drops) per high power field	Globules/HPF	{Globules}/[HPF]
gram	g	g
gram per 24 hour	g/24h	g/(24.h)
gram per 72 hour	g/72h	g/(72.h)
gram per decilitre	g/dL	g/dL
gram per litre	g/L	g/L
hour	h	h
international normalized ratio	no unit	{INR}
international unit per gram	IU/g	[IU]/g
international unit per litre	IU/L	[IU]/L
international unit per millilitre	IU/mL	[IU]/mL
kilo arbitrary unit per litre	kU/L	k[arb'U]/L
kilo enzyme unit per litre	kU/L	kU/L
kilo international unit per litre	kIU/L	k[IU]/L
kilo international unit per millilitre	kIU/mL	k[IU]/mL
kilogram	kg	kg
kilopascal	kPa	kPa
Litre	L	L
litre per 24 hour	L/24h	L/(24.h)
litre per litre	L/L	L/L
log (base 10) copies per millilitre	Log copies/mL	{Log_copies}/mL
log (base 10) international unit per millilitre	Log IU/mL	{Log_IU}/mL
metre	m	m

Description	Preferred Display	UCUM Unit
microgram	ug	ug
microgram per 24 hour	ug/24h	ug/(24.h)
microgram per decilitre	ug/dL	ug/dL
microgram per gram	ug/g	ug/g
microgram per litre	ug/L	ug/L
microgram per minute	ug/min	ug/min
Microlitre	uL	uL
Micrometre	um	um
micromole per 24 hour	umol/24h	umol/(24.h)
micromole per gram	umol/g	umol/g
micromole per kilogram	umol/kg	umol/kg
micromole per litre	umol/L	umol/L
micromole per millimole	umol/mmol	umol/mmol
milli enzyme unit per litre	mU/L	mU/L
milli international unit per litre	mIU/L	m[IU]/L
milli international unit per millilitre	mIU/mL	m[IU]/mL
milligram	mg	mg
milligram per 24 hour	mg/24h	mg/(24.h)
milligram per gram	mg/g	mg/g
milligram per litre	mg/L	mg/L
milligram per millimole	mg/mmol	mg/mmol
millilitre	mL	mL
millilitre per minute	mL/min	mL/min
millilitre per minute per 1.73 square metre	mL/min/1.73m2	mL/min/{1.73_m2}
millimetre	mm	mm
millimetre of mercury	mmHg	mm[Hg]
millimetre per hour	mm/h	mm/h
millimole per 24 hour	mmol/24h	mmol/(24.h)
millimole per kilogram	mmol/kg	mmol/kg
millimole per litre	mmol/L	mmol/L
millimole per mole	mmol/mol	mmol/mol
million colony forming unit per litre	10*6 CFU/L	10*6.[CFU]/L
million per litre	10*6/L	10*6/L
million per millilitre	10*6/mL	10*6/mL
minute	min	min
multiple of the median	MoM	{M.o.M}
nanogram per litre	ng/L	ng/L
nanomole per 24 hour	nmol/24h	nmol/(24.h)
nanomole per gram	nmol/g	nmol/g
nanomole per litre	nmol/L	nmol/L

Description	Preferred Display	UCUM Unit
nanomole per milligram	nmol/mg	nmol/mg
part per billion	ppb	[ppb]
per high power field	/HPF	/[HPF]
per microlitre	/uL	/uL
per year	/year	/a
percent	%	%
pH	no unit	[pH]
picogram	pg	pg
picomole per litre	pmol/L	pmol/L
ratio	no unit	{ratio}
second	s	s
signal to cutoff ratio	s/co	{s_co_ratio}
titre	titre	{titre}
trillion per litre	10*12/L	10*12/L
umol/gram dry weight divided by the age of patient in years	umol/g/year of life	umol/g/a
week	wk	wk

Appendix 1 - Members of Working Groups

Pathology Units and Terminology Standardisation Project

Steering Committee

1	Michael Legg (Leader)	Project Manager	RCPA / SA-IT-14-6-5 / Michael Legg & Associates
2	Christiaan G Swanepoel	Project Officer	RCPA
3	Debra Graves	Member	RCPA
4	Bryan Jones	Member	AAPP / Sonic
5	Vincent McCauley	Member	MSIA
6	Alastair Wilson	Member	DoHA Pathology Outlays Section
7	Roger Hewitt	Member	NEHTA
8	David Ellis	WG AP	Clinpath Laboratories
9	Robert Flatman	WG BC	Sullivan Nicolaides Pathology - Sonic
10	Leslie Burnett	WG GP	PaLMS Royal North Shore Hospital / Pathology North / NSW Health Pathology
11	Helen Wordsworth	WG H	Sullivan Nicolaides Pathology - Sonic
12	David Gillis	WG IP	Queensland Pathology
13	Vitali Sintchenko	WG M	ICPMR Westmead
14	Lawrie Bott	WG R	Hobart Pathology - Sonic
15	Graham Jones	WG U	SydPath St Vincents Hospital
	Kim Williams	Resigned	DoHA Pathology Outlays Section
	Donna Truran	Visitor	CSIRO
	Meagan Judge	Visitor	RCPA
	Michael Osborne	Visitor	Mater Health Services

Units

1	Graham Jones (Leader)	Leader	SydPath St Vincents Hospital
2	David Bryce	Member	RCPA QAP
3	Grahame Grieve	Member	Health Intersections
4	David McKillop	Member	NEHTA
5	Michael Osborne	Member	Mater Health Services

Biochemistry

1	Robert Flatman (Leader)	Leader	Sullivan Nicolaides Pathology - Sonic
2	Grahame Caldwell	Member	Douglass Hanly Moir - Sonic
3	Michael Osborne	Member	Mater Health Services
4	Doug Chesher	Member	PaLMS
5	Janice Gill	Member	RCPA QAP
6	Philip Baron /	Member	ACT Pathology
6	Ian Bull	Member	ACT Pathology
7	Kerry De Voss /	Member	QML - Primary
7	Greg Manz	Member	QML - Primary
8	David Deam	Member	Gribbles - Healthscope
9	Cecilia Hsieh /	Member	Melbourne Health
9	David Evans	Member	Melbourne Health
10	Nigel Brown	Member	PA Hospital, Brisbane

Anatomical Pathology

1	David Ellis (Leader)	Leader	SA Pathology & Clinpath Laboratories
2	Simon King	Member	SA Pathology
3	Martyn Peck	Member	RCPA QAP Anatomical Pathology
4	Eric Browne	Member	Montage Systems
5	Meagan Judge	Member	RCPA / Structured Pathology Reporting
6	David Papadimos (Cytopathology Leader)	Leader	Sullivan Nicolaides Pathology - Sonic
7	Paul Macdonald (Cytopathology)	Member	South Eastern Melbourne Medicare Local
8	Marion Saville	Member	Victorian Cytology Service
9	Liam Barnes	Member	NEHTA
	Damien Cunningham	Correspond	NEHTA
	Ruth Salom	Resigned	SA Pathology

Genetic Pathology

1	Leslie Burnett (Leader)	Leader	PaLMS Royal North Shore Hospital / Pathology North / NSW Health Pathology
2	Andrew Dubowsky	Member	Flinders Medical Centre -SA Pathology
3	Madhuri Prasad	Member	Sullivan Nicolaides Pathology - Sonic
4	Greg Peters	Member	Cytogenetics Dept Westmead
5	Doug Chesher	Member	PaLMS
6	Lynda Campbell	Member	Victorian Cancer Cytogenetics
7	John Beilby	Member	PathWest Laboratory Medicine WA
	Graeme Suthers	Correspond	Women's and Children's Hospital, Adelaide

Haematology

1	Helen Wordsworth (Leader)	Leader	Sullivan Nicolaides Pathology - Sonic
2	Michael Crowther	Member	RCPA QAP Haematology
3	Andrew Hudspeth	Member	Pathology Department Royal Hobart
4	Brett Cawley	Member	IT, PathWest
	Emmanuel J Favaloro	Resigned	Institute of Clinical Pathology, Westmead
	Gillian Rozenberg	Resigned	Department of Haematology SEALS

Immunopathology

1	David Gillis (Leader)	Leader	Pathology Queensland
2	Sue Jovanovich /	Member	RCPA QAP Immunology
3	Loretta Wheatland	Member	RCPA QAP Immunology
4	Daman Langguth	Member	Sullivan Nicolaides Pathology - Sonic
5	Matthew Cordell	Member	NEHTA
6	Roger Garsia	Member	Immunology, RPAH
7	Bob Wilson	Member	Pathology Queensland / Chair Lab Pract ASCIA

Microbiology

1	Vitali Sintchenko (Leader)	Leader	ICPMR Westmead Hospital
2	Susan Badman	Member	RCPA QAP Serology
3	Simon Winter	Member	SEALS, NSW
4	Elizabeth Hanley	Member	Australian Commission on Safety and Quality in Health Care
5	Tony Robinson	Member	ICPMR, Westmead Hospital
6	Chris Lynton-Moll	Member	CAL2CAL Australia
7	Joan Faoagali	Member	Pathology Queensland
8	Terry Flood	Member	ICPMR, Westmead Hospital
9	Michael Osborne	Member	Mater Health Services
10	John Merlino	Member	Concord Hospital
11	Peter Robertson	Member	SEALS Area serology Laboratory
	Paul Cohen	Resigned	RCPA QAP

Request

1	Lawrie Bott (Leader)	Leader	Hobart Pathology - Sonic
2	David Taylor	Member	PathWest, Retiring
3	Peter Wajngarten	Member	Healthscope
4	John Andrew	Alt Member PW	Healthscope
5	David McKillop	Member	NEHTA
6	Vincent McCauley	Member	Medical Software Industry Association
7	Ralph Hanson	Member	RACP
8	Leigh Murphett	Member	Diagnostic Services
9	John Bennett	Member	RACGP
10	Michael Osborne	Member	Mater Health Services
	Rob Lister	Resigned	Sonic

Appendix 2 – Links

LOINC - http://loinc.org/

NEHTA -http://www.nehta.gov.au/

RCPA - http://www.rcpa.edu.au

SNOMED -http://www.ihtsdo.org/

UCUM -http://unitsofmeasure.org/

Appendix 3 – Approved abbreviations

"Building blocks"	Abbreviation
Alpha	a-
Antibody/Antibodies	Ab
Antigen/s	Ag
Beta	b-
Cerebrospinal fluid	CSF
Delta	d-
Deoxyribonucleic acid	DNA
Epsilon	e-
Gamma	g-
High density lipoprotein	HDL
Human Leucocyte Antigen	HLA
Immunogloblin	Ig
Immunogloblin A	IgA
Immunogloblin E	IgE
Immunogloblin G	IgG
Immunogloblin M	IgM
Isoenzyme	Isoenz
Low density lipoprotein	LDL
Microscopy Culture and Sensitivity	MCS
Molecular weight	MW
Multiples of median	MoM
Red Blood Cell	RBC
Ribonucleic acid	RNA
Single stranded DNA	ssDNA
– **Species (class)**	spp.
– **Species (genus)**	sp.
Very high density lipoprotein	VHDL
Very low density lipoprotein	VLDL
White blood cell or leukocyte	WBC

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