NCSR and HL7

HL7 Australia

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Declaration of additional interests

Professor Digital Health, Flinders University

Fellow, Australian College of Health Informatics (FACHI)

Director, McCauley Software Pty Ltd

Member External expert advisory committee, Black Dog Institute, NSW

Member National Pathology Accreditation Advisory Committee (NPAAC)

Chair, IHE Australia

Board member IHE International

Co-Chair HL7 International Service Oriented Architecture (SOA) Working Group

Delegate and nominated Australian standards expert ISO TC215

Member HL7 Australia and Health Informatics Society of Australia (HISA)

Member PITUS and HL7 V2 messaging work groups

Clinical Messaging – Safety and quality principles

- **Positive and Negative acknowledgement of message delivery**
- **Unambiguous data definitions and coding**
- **Unambiguous patient/provider identification**
- **Security of transport**
- **Detection of missing and duplicate messages**
- **Support for workflow**

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HL7 V2 message Acknowledgements

- **Every message sent requires an acknowledgement from the receiver**
- **Acknowledgements reference the unique ID of the sent message**
- **Acknowledgement can be positive (Ack) or Negative (Nak)**
- **Negative acknowledgements contain information about the HL7 Segments and fields that are in error**
- **Single level (Original) or two-level (Enhanced) acknowledgment supported**

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HL7 V2 Message Acknowledgement - 2

Acknowledgment is determined by received message type (MSH-9) and received Message header acknowledgement flags (MSH-15,16)

MSH-9 – message type determines type of acknowledgement required

MSH-15 – Accept acknowledgement type

MSH-16 – Application acknowledgement type

Values for Both – Always (AL), Never (NE), Error (ER), Success (SU)

If both MSH-15 and 16 are not valued

=> Original mode acknowledgement = single level Application acknowledgement

=> Equivalent to MSH-15 = NE and MSH-16 = AL

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HL7 V2 Acknowledgement message types

Message Type Received	Receive Acknowledgement message type	Application Acknowledgement Message type (Mandatory)
Admission, Discharge, Transfer (ADT)	ACK	ACK
Observation result (ORU)	ACK	ACK
Order message (ORM)	ACK	ORR
Referral (REF)	ACK	RRI (may be multiple)

A receive acknowledgement message is only sent if two-level (enhanced) acknowledgement is in use

Message Acknowledgement in the NCSR

- NCSR always sends back two-level acknowledgements
- NCSR expects single-level (application) acknowledgment to sent message

- LAB (upload result): ORU => NCSR
  NCSR => LAB ACK (gateway/receive)
  msg validation including patient/provider
  ACK (application)

- LAB (request history): ORM => NCSR
  NCSR => LAB ACK (gateway/receive)
  msg validation including patient/provider
  ORR (application)
  NCSR => LAB ORU (history as observation)
  LAB => NCSR ACK

Safe HL7 V2 Acknowledgement processing

- Every message sent must have a corresponding acknowledgement response received and processed
- Systems must detect missing acknowledgments
- Negative acknowledgements (NAK) must have appropriate escalation. Automatic re-try is rarely appropriate except when timeout
- Timeouts must have a sanity threshold which results in escalation.
- Document information flow
- Acknowledgement failures are a common cause of clinical incidents

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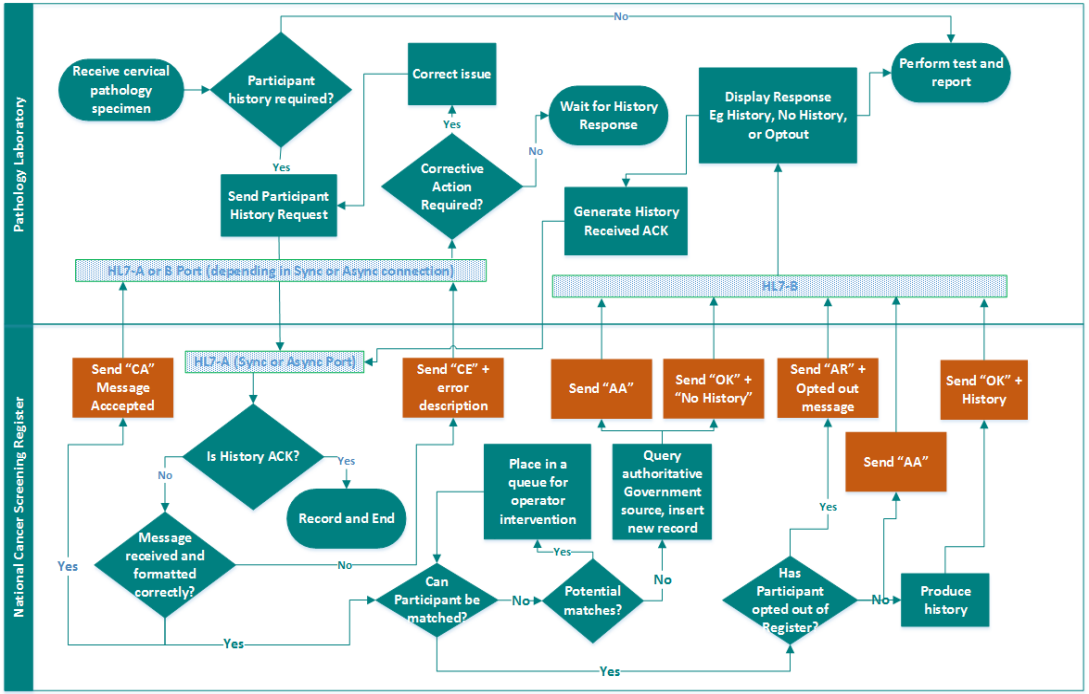
Pause ….


Handcrafted
GIN
NATURAL BOTANICALS
WE ARE
GIN-VINCE-ABLE!
CRAFTED BY:
DATE: 12/17
Mad Millie

Who is directing the traffic?

NCSR - HL7 Requesting Cervical Participant History Process



HL7 Message Transport

Secure VPN from each pathology Laboratory to NCSR

Separate links for upload and download

Transactions:

- **From Laboratory**
  - **Result Upload – ORU**
  - **History Request – ORM**
  - **Acknowledgments – ACK, ORR**
- **From NCSR**
  - **History return – ORU**
  - **Acknowledgements - ACK**

Safe usage of clinical identifiers

All well designed software systems have unique internal entity identifiers

Exchange of information is either trust based, exchange based or a hybrid of these

Trust based:

- Strong mutually agreed identifier(s) maintained by a trusted third-party e.g. government, with known governance as well as methodology for resolving issues

Exchange based

- Information supplied with sender's local identifier and sufficient additional information to permit matching to receiver's data.
- Receiver matches received data to local identifier and transmits receivers identifier AND senders identifier back to sender
- Both sender and receiver identifiers are included in all future exchanges.
- Requires mutual unique identifiers labelled with assigning authority
- This is supported by HL7 but not always mandated – implementation guides must mandate.

- NCSR assigns an NCSR patient identifier transmitted in all messages to labs.

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NCSR identifiers

Patient

- NCSR assigned patient identifier
- Laboratory assigned patient identifier
- IHI
- Medicare number with IRN
- DVA number
- Patient name
- DOB
- Sex
- Address

Provider

- HPI-I
- Medicare Provider number

Laboratory

- NATA number

Matching limitations

- **All matching algorithms will have an associated false positive match rate and false negative match rate**
- **The overall false matching rate is dependent on the matching algorithm AND the underlying statistical distribution of the match data.**
- **Many applications can tolerate either false negative or false positives better**
  - Use of DNA matches in criminal cases favours false negatives over false positives
  - Patient matching often set to minimise false positives e.g. “exact matching”
    - False negatives result in creation of duplicate patients requiring later merge
    - False positives result in “intertwined” patient records
    - Choose your poison
- **Due to the statistical nature of matching:**
  - As false negative matches decrease, false positive matches will increase
  - As false positive matches decrease, false negative matches will increase
  - Optimise total false match rate or the ratio of false negative to positive but not both
  - “You can mix them anyway you like but they will never leave”

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Terminology – safety and quality

- **Terminology determines the quality of Information that can be exchanged**

- **Semantic interoperability requires agreed terminology between exchange partners**

SNOMED – Systematic NOmenclature for MEDicine

- Originally developed by the American College of Pathologists
- Now managed by SNOMED International – an SDO
- Deeply hierarchical covering most medical domains
- Available only under licence (NOT free but have Australian National licence paid for by Federal Dept of Health)
- ADHA holds Australian national SNOMED licence
- Distributed by ADHA as monthly updates – downloadable text files and through the National Terminology Service (FHIR interface)
- Large – millions of terms
- Can be challenging to implement and use, due to size and complexity
- Defines a system of logical operators on SNOMED Terms = SNOMED expressions
- Agreed coding system in Australia for diagnosis, disease, Pathology orders. Also supports symptoms.
- Complex procedure to add new terms
- Australian Medicines Terminology (AMT) derived from SNOMED
- Tools – Free CSIRO Snapper and Shrimp – lookup and mapping

LOINC – Logical Observation Identifiers for Names and Codes

- Developed, managed and distributed by the Regenstrief Institute (USA)
- See www.loinc.org
- Each code contains values from 6 axes
  i. Component- what is measured, evaluated, or observed (example: urea,...)
  ii. Kind of property- characteristics of what is measured, such as length, mass, volume, time stamp and so on
  iii. Time aspect- interval of time over which the observation or measurement was made
  iv. System- context or specimen type within which the observation was made (example: blood, urine,...)
  v. Type of scale- the scale of measure. The scale may be quantitative, ordinal, nominal or narrative
  vi. Type of method- procedure used to make the measurement or observation

- Free and available for web download or using JSON/FHIR API
- Relatively easy to add new terms
- Australian agreed terminology for Pathology results
- Clinical LOINC – codes for disease, diagnosis , symptoms etc
- Comparatively simple to implement
- Free RELMA tool for LOINC mapping

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Examples of HL7 V2 terminology usage

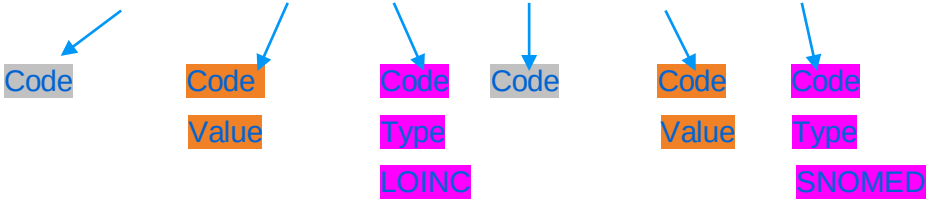
PID-8 1 IS O 0001 00111 Sex

Table for terminology (Appendix A)

Type	Table	Name	Value	Description
User	0001	Sex		
	0001		F	Female
	0001		M	Male
	0001		O	Other
	0001		U	Unknown

LOINC and SNOMED Codes:

CE|883-9^ABO Group^LN|1|F-D1250^Type O^SNM3



Terminology Mapping

- **Mapping is required when two or more systems use different code sets**
- **Mapping can be very simple e.g. sex –**
  - HL7 = [F, M, U, O]
  - AIHW = [1,2,3,4,5,9]

Or

- **complex e.g. LOINC to SNOMED potentially involving millions of terms**
  - So far >6.5K LOINC terms mapped to SNOMED here
- **Mapping is almost never 1:1 – see sex above**
- **Mapping tables are rarely complete**
- **Mapping tables may not be commutative –**
  - pathology LOINC code to MBS is n:1
  - MBS to LOINC code is 1:n
- **Mapping tables may not be transitive**

e.g. PBS => AMT => TGA then TGA => PBS may not produce the original PBS code

Terminology Mapping - continued

Terminology and Mapping Clinical Governance is the key to clinical safety

- Who is responsible for maintenance and new versions? – terminologies and maps
- How often is it updated?
- How are updates distributed and changes communicated?
- How are updates and map maintenance resourced
- What quality measures are in place? – completeness, audit, independent review, expertise
- Are the limitations of the map understood by all parties?
- Are the rules for dealing with unmapped values well defined?

- There is an ISO TC215 standard on clinical mapping quality measures.

NCSR example messages – Histopath upload

MSH|^~\&|LABSYS|GI^9999^AUSNATA|NCSR|NCSR|20170717222327+1000||ORU^R01|GI.36.20170717.27521235|P|2.4^AUS&Australia&ISO3166-1|||AL|AL|AUS|8859/1|en^English^ISO639
PID|1||125^^^LAB^MR~49502908701^^^AUSHIC^MC~8003608833353907^^^AUSHIC^NI||KENNEDY^DOT^^^^^L||19990319|F|||271 GILBERT PL^^DENISTONE^NSW^2114^^H
PV1|1|O|OP^^^^^^^outpatient|R||||4445758F^GLADMIN^BOB^^^Dr^^^AUSHICPR
ORC|RE||1100002-1^GI^9999^AUSNATA||CM
OBR|1||1100002-1^GI^9999^AUSNATA|252416005^Histology Cancer Narrative^SCT|||20160714093000+1000|||4445758F^GLADMIN^BOB^^^Dr^^^AUSHICPR||||20160714113000+1000||4445758F^GLADMIN^BOB^^^Dr^^^AUSHICPR||||LN=1100002||20170717222327+1000||LAB|F||^^^20160714000000+1000^^R^^ROUTINE|||||0626518F&DOCTOR&PAUL&&&Dr&&&AUSHICPR
OBX|1|CE|72135-7^Diagnosis^LN|1.1|site 1 code^description^SCT||||||F
OBX|2|CE|72135-7^Diagnosis^LN|1.1.1|procedure 1 code^description^SCT||||||F
OBX|3|CE|72135-7^Diagnosis^LN|1.1.1.1|finding 1 code 1^description^SCT||||||F
OBX|4|CE|72135-7^Diagnosis^LN|1.1.1.2|finding 1 code 2^description^SCT||||||F
OBX|5|CE|72135-7^Diagnosis^LN|1.2|site 2 code^description^SCT||||||F
OBX|6|CE|72135-7^Diagnosis^LN|1.2.1|procedure 1 code^description^SCT||||||F
OBX|7|CE|72135-7^Diagnosis^LN|1.2.1.1|finding 1 code^description^SCT||||||F
OBX|8|CE|72135-7^Diagnosis^LN|1.2.1.2|finding 2 code^description^SCT||||||F
OBX|9|CE|72135-7^Diagnosis^LN|1.2.1.3|finding 3 code^description^SCT||||||F
OBX|10|CE|72135-7^Diagnosis^LN|1.3|site 3 code^description^SCT||||||F
OBX|11|CE|72135-7^Diagnosis^LN|1.3.1|procedure 1 code^description^SCT||||||F
OBX|12|CE|72135-7^Diagnosis^LN|1.3.1.1|finding 1 code^description^SCT||||||F

NCSR Example messages
History request

MSH|^~\&|LIS|Pathology Lab^9999^AUSNATA|NCSR|NCSR|20170524110726+1000||ORM^O01|XX05242224066-1191|P|2.4^AUS&Australia&ISO3166-1|||AL|AL|AUS|8859/1

PID|1||999006^^^LAB^MR~50696976461^^^AUSHIC^MC||YUMYUMRS^CAROLEF^^^MS^^L||19750117|F||9|222 LONSDALE ST^^MELBOURNE^VIC^3000^^M||0491570156

ORC|NW|00004428-1^Pathology Lab^9999^AUSNATA|||||^^^2005||20160916220216+1000||||||20160916220216+1000|410513005^In thepast^SCT

OBR|1|00004428-1^Pathology Lab^9999^AUSNATA||^*|||||||G|||||||||LN=00004428||||LAB

NCSR Example messages – History response – no history found

MSH|^~\&|NCSR|NCSR|LIS|Pathology Lab^9999^AUSNATA|20170524110726+1000||ORU^R01|XX05242224066-1191|P|2.4^AUS&Australia&ISO3166-1|||AL|NE|AUS|8859/1

PID|||999006^^^LAB^MR~50696976461^^^AUSHIC^MC||YUMYUMRS^CAROLEF^^^MS^^L||19750117|F|||222 LONSDALE ST^^MELBOURNE^VIC^3000^^M||0491570156

ORC|OK|00004428-1^Pathology Lab^9999^AUSNATA||1

OBR|1|1100002-1^GI^9999^AUSNATA||5491000179105^Medical record summary^SCT|||||||No previous history found|

NCSR Example messges – History response with history

MSH|^~\&|NCSR|NCSR|LIS|Pathology Lab^9999^AUSNATA|20170524110726+1000||ORU^R01|XX05242224066-1191|P|2.4^AUS&Australia&ISO3166-1|||AL|NE|AUS|8859/1
PID|||999006^^^LAB^MR~50696976461^^^AUSHIC^MC||YUMYUMRS^CAROLEF^^^MS^^L||19750117|F||222 LONSDALE ST^^MELBOURNE^VIC^3000^^M||0491570156
ORC|OK|00004428-1^Pathology Lab^9999^AUSNATA||1
OBR|1|00004428-1^Pathology Lab^9999^AUSNATA||35904009^ Human papillomavirus DNA detection ^SCT|||20160714093000+1000||||||20160714113000+1000|||||LN=1100002||20170717222327+1000||LAB|F
OBX|1|CE|53903-1^HPV COLL METHOD^LN||A1^Practitioner-collected sample||||||F
OBX|2|CE|19763-2^HPV Spec Site^LN||B1^Cervical||||||F
OBX|3|CE|67098-4^HPV Reason^LN||C1^Primary screening HPV test||||||F
OBX|4|CE|77379-6^HPV test result 1 - onc^LN|1|DU^Unsatisfactory|||||F
OBX|5|CE|8262-8^HPV Test Type^LN||E1.1^Qiagen Hybrid Capture II||||||F
OBX|6|CE|20430-5^HPV Test Sample^LN||F1^PreservCyt Solution|||||F
OBX|7|CE|19774-9^NCSR program^LN||HPV^HPV renewal program|||||F
OBX|8|FT|TXT^Display format in text^AUSPDI||\.br\ HPV Collection Method Practitioner-collected sample\.br\ HPV Spec Site Cervical\.br\ Reason for HPV Test Primary screening HPV test\.br\ HPV test Result 1 Unsatisfactory\.br\ HPV Test Type Qiagen Hybrid Capture II\.br\ HPV Test Sample PreservCyt Solution\.br\ NCSR program HPV renewal program\.br\ NCSR Risk U\.br\ NCSR SI Num 17\.br\ NCSR Test Case SYS CRV-2.1.8u2\.br\ NCSR Test Description Under age\.br\^||||||F
ORC|OK|00004428-1^Pathology Lab^9999^AUSNATA||2
OBR|1|00004428-1^Pathology Lab^9999^AUSNATA||417036008^Liquid based cervical cytology screening^SCT|||20160714093000+1000||||||20160714113000+1000|||||LN=1100002||20170717222327+1000||LAB|F
OBX|1|CE|19771-5^Specimen type^LN||A2^Liquid Based specimen|||||F
OBX|2|CE|19763-2^Specimen Site^LN||B1^Conventional Cervical|||||F
OBX|3|CE|67098-4^Reason for test^LN||C1^Reflex LBC cytology after detection of oncogenic HPV in primary screening H|||||F
OBX|4|CE|19762-4^Result S^LN||SU^Unsatisfactory for evaluation, for example, poor cellularity, poor preserva||||||F
OBX|5|CE|19765-7^Result E^LN||E1^Endocervical component present. No abnormality or only reactive changes.||||||F
OBX|6|CE|19766-5^Result O^LN||O5^Possible high-grade lesion - non-cervical||||||F
OBX|7|CE|19774-9^NCSR program^LN||HPV^HPV renewal program|||||F
OBX|8|FT|TXT^Display format in text^AUSPDI||\.br\ Specimen type \H\Liquid Based specimen\N\\.br\ Specimen Site \H\Conventional Cervical\N\\.br\ Reason for test \H\Reflex LBC cytology after detection of oncogenic HPV in primary screening H\N\\.br\ Result S \H\Unsatisfactory for evaluation, for example, poor cellularity, poor preserva\N\\.br\ Result E Endocervical component present. No abnormality or only reactive changes.\.br\ Result O \H\Possible high-grade lesion - non-cervical\N\\.br\ NCSR program HPV renewal program\.br\^||||F
ORC|OK|00004428-1^Pathology Lab^9999^AUSNATA||3
OBR|1|00004428-1^Pathology Lab^9999^AUSNATA||252416005^Histology Cancer Narrative^SCT|||201307051230+1000||||||||||||||||SP
OBX|1|FT|22637-3^Pathology report final diagnosis Narrative^LN||CONCLUSION: CERVICAL BIOPSY: CIN2 & 3, HPV changes.||||||F

Thank you