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MACH - Safety and Rescue Project Research Report

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Document information

Version	Updated by	Revision date	Summary of changes
0.1	Alexander Roche	23/09/2021-10/10/2021	Draft version for initial review

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1. Introduction

1.1 Project background and drivers

1.1.1 Background

Healthcare institutions and professionals in Victoria are required to maintain currency in a well-established range of competencies such as hand hygiene, basic and advanced life support, and safe handling of blood, etc. Each institution and each individual share the responsibility for demonstrating completion of this training.

The training is conducted either within the Learning Management System (LMS) of the hospital or via a central provider such as Hand Hygiene Australia. When an individual has not completed the local course in a hospital (generally they will be automatically enrolled based on their job classification), they can either complete the training or request recognition of prior learning (RPL). The latter is generally a laborious and repetitive process and one that could easily be automated by creating a centralised learning record system that enables administrators to check training history online. Offering this solution may help reduce cost, delays in starting work and increase the quality and immediacy of the relevant data.

To establish and test a practical, technical solution, the Melbourne Academic Centre for Health (MACH) asked Educational Technology infrastructure specialist Androgogic to establish a centralised system of collecting and disseminating training records. Two leading hospitals were invited to participate: Austin Health and Eastern Health.

1.1.2 Project participants

The project participants included MACH, Austin Health, Eastern Health and Educational Technology services provider, Androgogic Pty Ltd.

1.1.2.1 MACH

"The Melbourne Academic Centre for Health (MACH) is a joint venture between 19 full partners, including 10 Victorian healthcare providers, 8 independent medical research institutes and the University of Melbourne, with La Trobe University as an affiliate member. Across this partnership, which has nearly 40,000 staff, around $7 billion is invested each year in health care, research and education.

The MACH partnership brings together health services, health scientists and healthcare consumers committed to translation of interdisciplinary research that will benefit patients and strengthen the economy. We address current health challenges by delivering precision care tailored to the needs of patients, developing world-leading research into tomorrow's healthcare and nurturing future leaders of innovative care. We work collaboratively across our 19 partners, and with the broader medical and

scientific community, Australian governments, industry partners and healthcare consumers to fulfil MACH's potential to be Australia's leading health transformation partnership."

Source: https://machaustralia.org/about-us/

This project was initiated by the MACH Education and Workforce Planning Committee which has an initial focus on three key priorities including:

- Identifying opportunities for interprofessional education and practice across the MACH network.
- Identifying and enacting educational research priorities to ensure consistent and effective education of practitioners across the expertise continuum.
- Establishing a Clinical PD passport

MACH has initiated and funded this project This project aims to address the Clinical PD passport which has been identified as one of the highest priorities amongst multiple partners.

Committee membership:

- Prof Elizabeth Molloy (UoM) (Chair)
- Dr Amy Gray (RCH)
- Mr Robert LoPresti (AH)
- Dr Jason Goh (RVEEH)
- Prof Stephen Lew (WH)
- Prof Marie Gerdtz (UoM)
- Jason Micallef (UoM)
- Sandy Schutte (WH)
- Prof Steve Trumble (MMS)
- Prof Justin Tse (St V's)
- Michelle Iddles (MACH)
- Dr Leonie Griffiths (NH)
- Dr David Smallwood (MH)
- Jenni Smith (NH)

1.1.2.2 Eastern Health

"*Eastern Health is one of Melbourne's largest metropolitan public health services. We provide a range of emergency, surgical, medical and general healthcare services, including maternity, palliative care, mental health, drug and alcohol, residential care, community health and statewide specialist services to people and communities that are diverse in culture, age, socio-economic status, population and healthcare needs.*"

Source: https://www.easternhealth.org.au/site/item/2-about-us

1.1.2.3 Austin Health

"We're recognised for our high-quality, safe, person-centred care, our leading teaching and research and as a place where staff and volunteers are proud to work.

We're renowned for our specialist work in cancer, infectious diseases, obesity, sleep medicine, intensive care medicine, neurology, endocrinology, mental health and rehabilitation.

We're also the largest Victorian provider of training for specialist physicians and surgeons.

We deliver services for patients across four main sites in Melbourne, in locations across our community, in people's homes, and within regional hospitals across Victoria.

We're an internationally recognised centre of excellence in hospital-based research.

Across our sites, almost 1,000 researchers and a number of research institutes, universities and the Mercy Hospital for Women work together in an alliance called Austin LifeSciences.".

Source: https://www.austin.org.au/about/

1.1.2.4 Androgogic

"Androgogic is acknowledged as a leading provider of Educational Technology strategy and systems and has the ability to realise an integrated, enterprise Educational Technology architecture for educational institutions in practical, functionally rich and cost effective deployments in support of strategic business initiatives.

The company was established in 2005 with a strategic objective of creating a highly specialised and experienced team of Educational Technologists capable of offering advice, assistance and detailed support in the complex business of designing and implementing robust, enterprise-wide Educational Technology system deployments in support of online learning initiatives ranging from small colleges to multinationals.

This experience is realised in expertise with a broad range of online learning systems including SaaS provision of:

- *The Totara and Moodle Learning Management Systems (LMSs)*
- *The Totara Learning Experience Platform (LXP)*
- *The Totara performance Management System*
- *The AndroLCMS Learning Content Management Systems*
- *The Androlytics xAPI Learning Record Store (LRS)*
- *The Mahara ePortfolio system"* Source: https://androgogic.com/about

Androgogic is a also key Educational Technology partner providing the Software As A Service Totara Learning management system to the following Healthcare institutions:

Healthcare institution		
Advance Care Planning	Eastern Health	Peninsula Health
Ambulance Victoria	Estia Health	Perth Children's Hospital
Alfred Health	Goulburn Valley Health	Peter MacCallum Cancer Centre
Allity Aged Care	Health Direct	Royal Children's Hospital, Melbourne
Androgogic	HealthShare Victoria	Royal Melbourne Hospital
Austin Health	McGrath Foundation	Royal Womens Hospital
Ballarat Health	Mecwacare	Salvation Army
Bendigo Health	Medcast	South West Alliance of Rural Health

Catholic Healthcare	Mercy Health	Saint John of God Health Care
Central Adelaide Local Health Network including the Royal Adelaide Hospital	Northern Health	Uniting AgeWell
East Grampians Health Service	NSW Health	Western Health

1.1.2.5 Project personnel

Name	Responsibility
Leanne Saxon, Research Fellow, Melbourne Academic Centre for Health	Sponsorship, leadership, representation of MACH interests, Core Project Team
Rob Lopresti, Director, Clinical Education Unit, Austin Health	Sponsorship, leadership, representation of MACH interests, Core Project Team
Dale Chadwick, Learning Technology Manager, Austin Health	LMS administration responsible for selecting courses and updating user data as required
Peter Mellow, Director, Learning Design and Systems, Learning and Teaching Directorate, Eastern Health	Sponsorship, leadership, representation of MACH interests, Core Project Team
Mathew Carson, Digital Learning Coordinator, Eastern Health	LMS administration responsible for selecting courses and updating user data as required
Alexander Roche, Principal Educational Technologist, Androgogic	Androgogic Executive Lead, Core Project Team
Praj Basnet, Senior Software Engineer, Androgogic	Androgogic Senior Software Engineer responsible for LRS deployment and configuration
Annie Thomas, Test Lead, Androgogic	Test Lead responsible for test design and implementation
Aparna Muruganandam, Professional Services Technician	Professional Services Technician responsible for system configuration, testing and data collation

1.2 Objectives of the research

The objectives of the project were to examine the need, feasibility, efficacy and acceptability of introducing a centralised data-storing system on compulsory training for health care professionals working across AH and EH such that their training data can be passed programmatically between the hospitals.

It was posited that:

> *"The introduction of a centralised learning record system will reduce the time, stress and money (in man-hours) it takes for clinical staff to begin work at a new hospital.*
>
> *Before starting work, staff are required to complete core training (such as hand hygiene and basic life support), however, if they have completed these at a different institution they need recognition of prior learning (RPL). This can be a laborious and time-consuming process for both the clinical staff and LMS administrators.*
>
> *This process can be improved by introducing an on-line centralised learning record store that will allow administrators to look up the training records and avoid inviting new staff to attend a course they have already completed.*
>
> *It is not to be underestimated the amount of goodwill this will generate amongst all involved."*
>
> Source: 20190417 - Austin Health QI-Audit form v4 - Final[1]

1.3 Purpose of this document

This document is a report on the research project. In addition to the background and drivers for the project it includes a description of the methodology used and the results captured. Finally, it also includes a set of conclusions based on the project results.

2. Methodology

2.1 High level project methodology

The project was conducted in a series of phases as follows:

Phase	Description
Ethics review phase	Reviews conducted by the Ethics Committee of both Eastern Health and Austin Health that suitable data privacy would be maintained.

Design phase	Phase to collaboratively design the data required (model) and the collection methodology including user and course matching logics
Implementation phase	Phase to build the data exchange and matching system (build and integrate)
Data collection phase	RPL data transmitted between the AH and EH production LMSs
	Project participant interviews
Testing phase	Test all systems conform to the requirements in the design documentation
Report phase	Collate results and construct research report

2.2 Ethics review

The proposed project methodology and data to be exchanged was presented to the ethics Committees of both Eastern Health and Austin Health for review. In each case, the project was permitted to proceed.

2.3 Design

2.3.1 Design workshops

The design of the research project was established in collaboration between the project participants in a series of design workshops and meetings as follows:

Workshop/meeting	Purpose	Stakeholders	Time required
Project Kick-off meeting	Open project and review Statement of Work and establish the Project Management Plan approach	Project manager Core project members	1 hour
Data modelling	Establish the data model and data flows	Project manager Core project members	Series of Zoom meetings

LRS and integration configuration workshop	LRS and LMS configuration on Test to establish the plan for production reflecting the project business requirements	Androgogic Ed Techs AH and EH LMS administrators	2 hours
Review meetings	Meetings to review progress and plan next steps	Project manager Core project members	Series of Zoom meetings

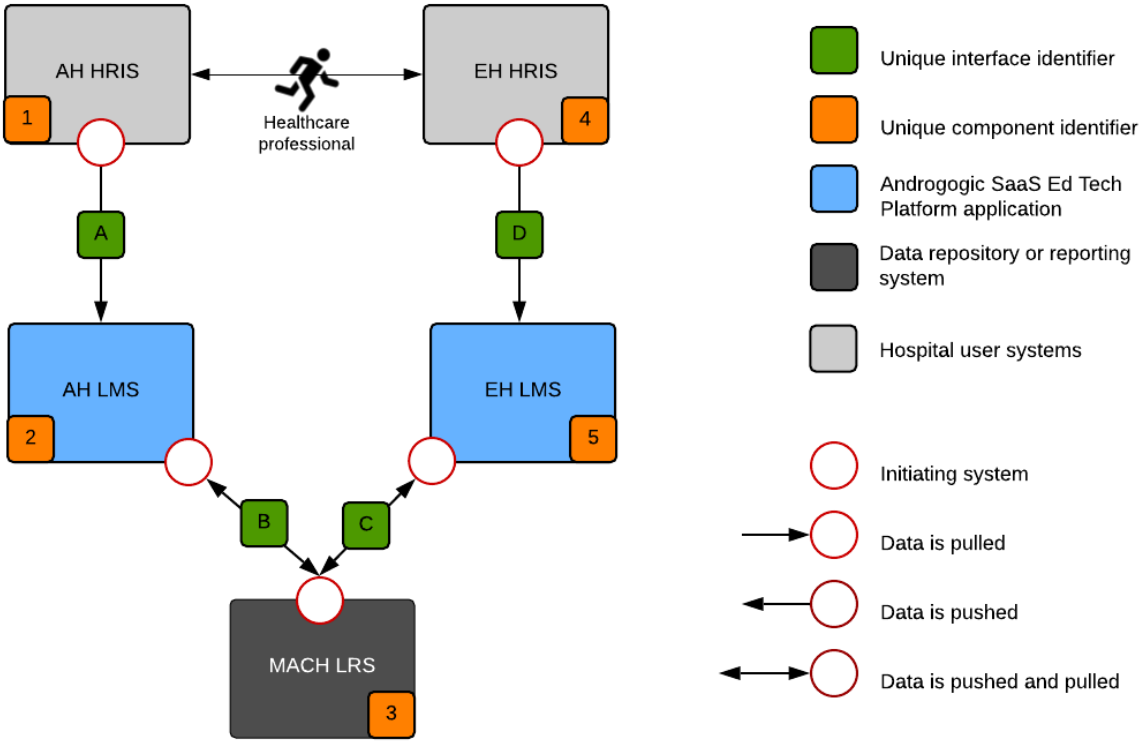
At a high level, outcomes of the design workshops determined that the following project tasks were to be conducted:

- Establish a Learning Record Store (LRS) to store learning records from Austin Health & Eastern Health.
- Use xAPI data exchange plugin for Totara LMS to integrate the participating institutions.
- Select representative courses in each institution to be used for the pilot
- Configure target courses and plugins and review learning record exchange
- Mature and document the user data model and the matching logics for both clinical and non-clinical personnel

2.3.2 Data collection design

2.3.2.1 System integration architecture

The resulting test design was as follows:



2.3.2.2 System components

Component ID	Name	Description
1	Austin Health HRIS	Austin Health's Human Resources Information System (HRIS).
2	Austin Health LMS	Austin Health's Learning Management System (LMS) 'Atlas' built on the Totara Learn LMS and Androgogic's Totara Plus plugin suite. This is a Software As A Service system supplied by Androgogic to Austin Health independent of this project via https://atlas.austin.org.au.
3	MACH LRS	Learning Record Store deployed for MACH for the purposes of this research project using Androgogic's Andrologics xAPI LRS software. This is a Software As A Service system supplied by Androgogic for the duration of the project.
4	Eastern Health HRIS	Eastern Health's Human Resources Information System (HRIS).
5	Eastern Health LMS	Eastern Health's Learning Management System (LMS) 'iLearn' built on the Totara Learn LMS and Androgogic's Totara Plus plugin suite.

		This is a Software As A Service system supplied by Androgogic to Eastern Health independent of this project via https://ilearn.easternhealth.org.au.

2.3.2.3 System integration interfaces

Integration ID	Name	Description
A	AH HRIS - AH LMS	Existing user data integration between the Alfred Health Human Resources Information System (HRIS) and the Austin Health Learning Management System (LMS).
B	AH LMS - MACH LRS	Two way user course completion data integration between the Austin Health Learning Management System and the MACH Learning Record Store (LRS).
C	EH LMS - MACH LRS	Two way user course completion data integration between the Eastern Health Learning Management System and the MACH Learning Record Store (LRS).
D	EH HRIS - EH LMS	Existing user data integration between the Eastern Health Human Resources Information System (HRIS) and the Eastern Health Learning Management System (LMS).

2.3.2.4 About xAPI

The Experience API (xAPI) standard allows learning content and learning systems to speak to each other & track all types of learning experiences. It was created as 'Tin Can' in 2012 by the Advanced Distributed Learning (ADL). ADL initiated and administers the now prevalent SCORM and IMS standards and is the preeminent Educational Technology Standards body.

As the xAPI standard matured it was renamed as 'Experience API' or 'xAPI' and various reference implementations were conducted to allow the standard to be refined.

In 2021 it is now fully mature and we are starting to see support for xAPI appear in commoditised Educational Technology applications such as Learning Management Systems.

Early adopters have reported difficulty grappling with what should be stored and how it can be reported. Areas where the reporting is already defined such as compliance and Continuing Professional Development regimes effectively removes this barrier. In fact, as a standardised approach to collecting, storing and disseminating learning records, xAPI is ideally suited to filling the role of a centralised database in these areas.

2.3.2.4.1 Why use xAPI?

xAPI was selected to inform the integration via a Web services modality using the xAPI formatted Representational State Transfer (REST) software architectural style. xAPI is an international, Educational Technology standards-based specification. It was chosen in order to ensure an architecture that could be used across multiple institutions each with different learning systems and with the expectation that those systems will support a modern standard such as xAPI making the barrier to entry to the program lower and less costly.

2.3.2.4.2 xAPI resources

Resource	URL
General introduction to xAPI	https://en.wikipedia.org/wiki/Experience_API
xAPI specification	https://github.com/adlnet/xAPI-Spec/blob/master/xAPI-About.md#partone

2.3.2.5 User data model & matching logic

2.3.2.5.1 User records

The records targeted for exchange were as follows:

1. User data sufficient to identify the user and allow interoperation of records both between the LMS and the LRS and across LMSs via the LRS
2. Course enrolment and completion data including start and completion dates

2.3.2.5.2 User matching logic

It was established that users would be matched on key personal metadata present in both systems including:

- Firstname
- Lastname
- Email
- Date of Birth
- AHPRA number

User metadata matching methodology was as follows:

It was identified that Email would only rarely be reliable and so AHPRA number (for clinicians) and Date of Birth (for all users but specifically for non-clinicians) would be required in the matching ruleset.

2.3.2.5.3 Match level

The import sought to match users to existing accounts in the LMS using the following logic:

Match level	Description	Action
Matched	The import record closely matches a record in the LMS	The matched LMS record will be updated
No match		A new LMS record will be created
Review	The import record matches partly with an existing LMS record or matches with multiple LMS records	The import record is skipped and logged in the Sync Log for the attention of an administrator. Also logged are the matching LMS records.

2.3.2.5.4 Record matching logic

The matching logic was configured by setting the fields for each of the sections below in the relevant part of the plugin settings as follows

Match level	Matching logic
Matched	The record matches **idnumber** and 3 or more the following fields: • first name • last name • email • date of birth • AHPRA number
No match	No match found
Review	More than one match found, possible duplicate accounts

	OR Partial match found, eg matched **AHPRA** with less than multiple user accounts

Once the matching process is complete and the user is matched or unmatched, the incoming user record is used to either update an existing user record.

If the records remains 'Review', the record will not be processed further except to flag the record as 'unsure' so that it may be actioned by an administrator.

2.3.2.6 Course data & matching logic

2.3.2.6.1 Course mapping

Course - SOURCE	**Course in Austin Health**	**Course in Eastern Health**
Aboriginal Cultural Awareness	Aboriginal Cultural Awareness	Aboriginal Cultural Awareness Training
Hand Hygiene	Hand Hygiene	Hand Hygiene (Clinical)
Basic Life Support	Basic Life Support	Management of Acute Deterioration (incorporating BLS) - Practical Component

Course - DESTINATION	**RPL Course in Austin Health**	**RPL Course in Eastern Health**
Aboriginal Cultural Awareness	Aboriginal Cultural Awareness RPL	Aboriginal Cultural Awareness RPL
Hand Hygiene	Hand Hygiene RPL	Hand Hygiene RPL
Basic Life Support	BLS RPL	BLS RPL

2.3.2.6.2 Course matching

Courses were matched on Course ID number which must be unique within each system. Three courses in each LMS were selected and mapped to the corresponding course in the other LMS using the same Course Id Numbers.

To avoid the research potentially corrupting production data and related reporting in either system, matching training records were added to a new container course during the data collection period. Course completion was marked as 'Complete via RPL'.

Details of the record data model are available *Appendix A: Safety And Rescue LRS Project - User Data and Data Workflows.*

2.3.2.6.3 Course completion

Course completion for matched users were collected in the target courses using RPL completion settings. Completion records were also tagged as *'Complete via rpl'*.

2.3.3 Management of user data privacy & confidentiality

Successful Ethics Committee reviews were conducted by both participating hospitals. This included an examination of the data to be transferred between institutions.

Personal user metadata was reduced to the minimum required to be able to
Only LMS staff who currently have access to the clinical staff's learning records will have access to the new learning record store. Information on whether a staff member has completed a mandatory course will be shared across the two hospitals. No other information will be shared. AHPRA numbers will be used to search a person's training history.

2.3.4 Project participant interviews

Project participant interviews were conducted as a means to draw insight into challenges and opportunities perceived during the project. The interviews were conducted by Leanne Saxon using the instruments presented in Appendix B. Interviews were recorded with the permission of the interviewees and subsequently transcribed.

2.4 Implementation

The high level implementation methodology for the project was as follows:

1. Deploy and configure and test the (LRS)
2. Deploy a dedicated Learning Record Store (LRS) (using Androgogic's LRS software 'Androlytics LRS) for the trial and configure against the target data model
    a. Build test and production LRS servers
    b. Implement domain name DNS setup using machlrs.androgogic.com.au and machlrstest.androgogic.com.au

   c. Install AndroLytics LRS and configure as per design documentation
   d. Configure endpoint integration sources in the Test then Prod LMSs
   e. Setup Tier 2 support pathway to Androgogic Request Tracker support system and load MACH core project users
3. Integrate the two participating institutions LMSs via the LRS
   a. Deploy the xAPI data exchange plugin for Totara LMS to the Austin Health and Eastern Health Totara Learn LMSs
   b. Configure the plugins and the LRS for secure access (Restful webservice with credentialled access, IP origination restriction and and TLS 1.2 security certification) and test
4. Arrange AHPRA number and Date of Birth metadata in each LMS's HRIS user data integrate data set
5. Configure each LMS with custom course metadata attributes to allow identification of the compliance course
6. Liaise with the LMS administrators to:
   a. Identify the courses for use in the trial
   b. Set the compliance and course id metadata
7. Test the emission and receipt of xAPI statements (learning records)
8. Collate results
9. Document the trial methodology and results in a (this) research report

2.5 Testing

At a high level, the test phase targeted the determination that the LRS had been deployed, the LMS endpoints had been configured and that RPL data was flowing successfully between EH and AH LMSs in both directions. It also tested that the matching methodology for both user and courses was operational and that the data could be examined. Testing was also repeated on a series of checkpoint dates during the data collection phase and again at the end of the period.

2.5.1 Test scenarios

- User profile tests
  - Same AHPRA number but:
    - Different email - user should still be matched
    - Different name - user should still be matched
    - Different DoB - should not match - throw trace error in log
  - No AHPRA number but fn, ln, dob match - - user should still be matched
- Course data tests
  - Single course-to-course transfer
  - Multiple courses - e.g. BLS two separate courses at EH

- (Note don't currently have support for one to multi-course mapping as Totara insists on Course Id being unique
- Both directions (tests all the sources):
  - AH>EH
  - EH>AH
- Courses in Programs:
  - Courses in Programs (on EH) (user needs to be assigned to the Certification) - RPL in course should have the Program completed
  - Courses in Certifications (both AH and EH)
  - Expired scenario test

3. Results

3.1 High level results

At a high level, the integration was able to match users across both hospitals and for the three courses used in the study, 1,049 users were matched and completions applied in Eastern Health's LMS and 143 in Austin Health's LMS.

There were some concerns regarding the Austin numbers as the data flow from Eastern to Austin was interrupted by a major version upgrade of the LMS software. This was not anticipated to impact the study, however it may have and this may explain the lower numbers for Austin.

Comparing users across both LMS [07/10/2021]		
	AU	**EA**
Total in extract	19399	49774
Less users without DOB & AHPRA	1582	9619
Less Andro users	39	97
Remaining users	17778	40058
Users with DoB	17817	40133
Users with AHPRA1	5743	7397
Users with AHPRA2	3	212
Identical AHPRAs	1	10
Austin-Eastern DoB matching users	2858	

Austin-Eastern AHPRA1 matching users	184	
For the courses identified	**AU**	**EA**
DoB matches on 07.10.2021	132	1368
AHPRA1 matches on 07.10.2021	89	108
For the courses identified - UNIQUE users	**AU**	**EA**
DoB matches on 07.10.2021	84	981
AHPRA1 matches on 07.10.2021	59	68
Total	143	1049

3.2 User matching results

3.2.1 Total individual user matching results summary by institution

Institution	**Total individual users matched**
Austin Health	143
Eastern Health	1049

3.2.2 User matching for courts completions in 12 months (08/10/2020-07/10/2021)

Institution	**Total individual users matched in 12 months (08/10/2020-07/10/2021)**
Austin Health	5
Eastern Health	191

3.2.3 User matching issues

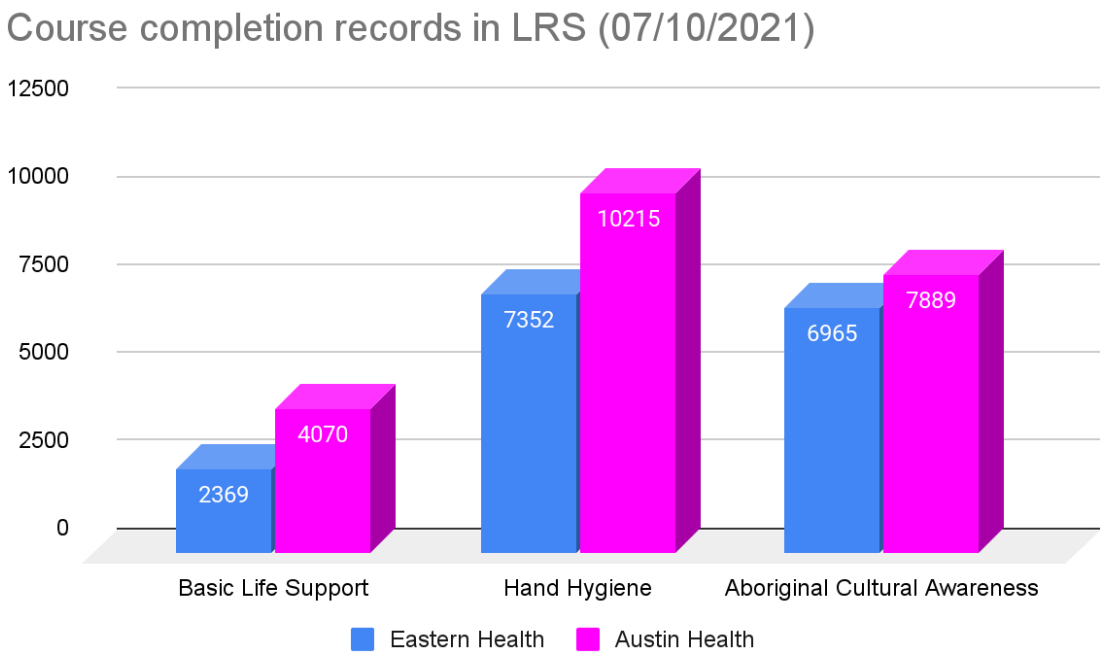
User matching issues included the following:

- User data had to be adjusted in either system (in the institution's HRIS) before a rich enough data model could be established for user matching (both institutions had to conduct a once-off exercise to add AHPRA and DoB data and also to them include the acquisition of that data in future staff onboarding processes)

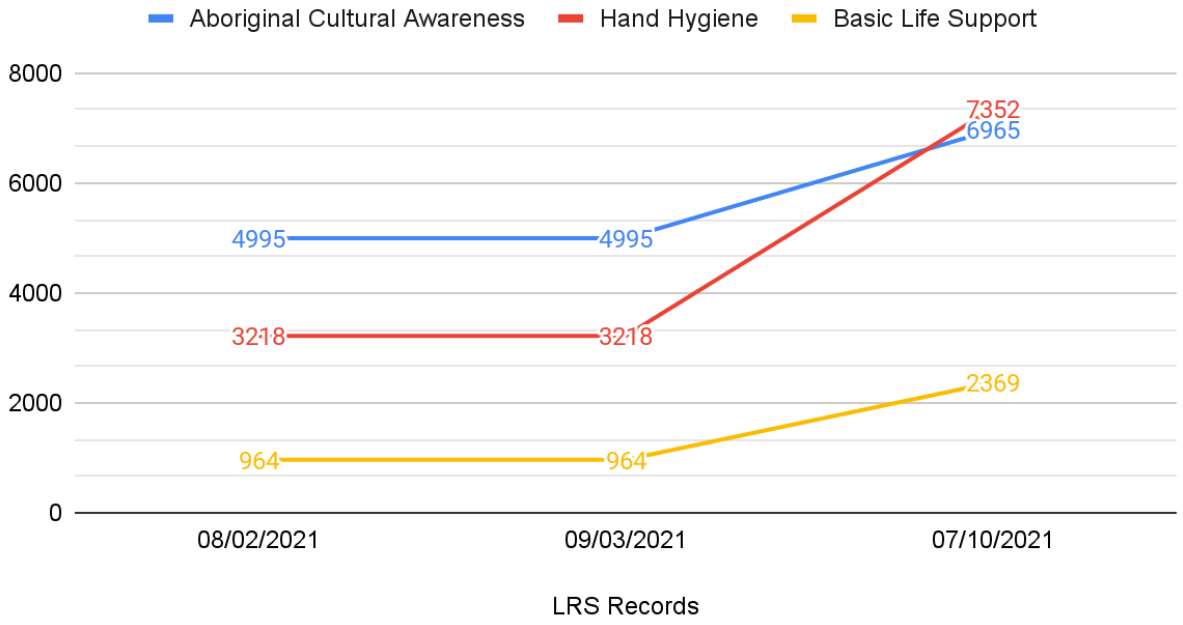
- User's can have more than one AHPRA number if they have more than one clinical role. The matching system in the integration software was updated to match on more than one AHPRA number however this was deemed to have failed when the log data was examined at the end of the project
- DoB though useful in the matching is considered by many people as sensitive personal data and so produces a higher barrier for entry of an institution as a participant in the data exchange.

3.3 Course matching & completion results

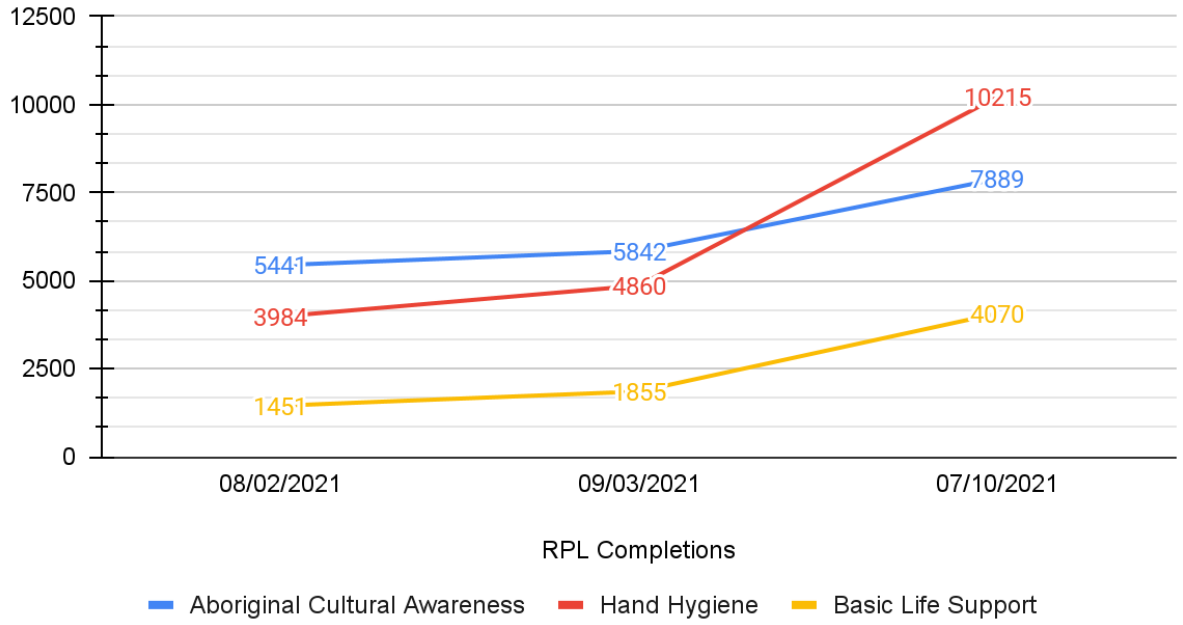
3.3.1 Course completion records in LRS (latest)



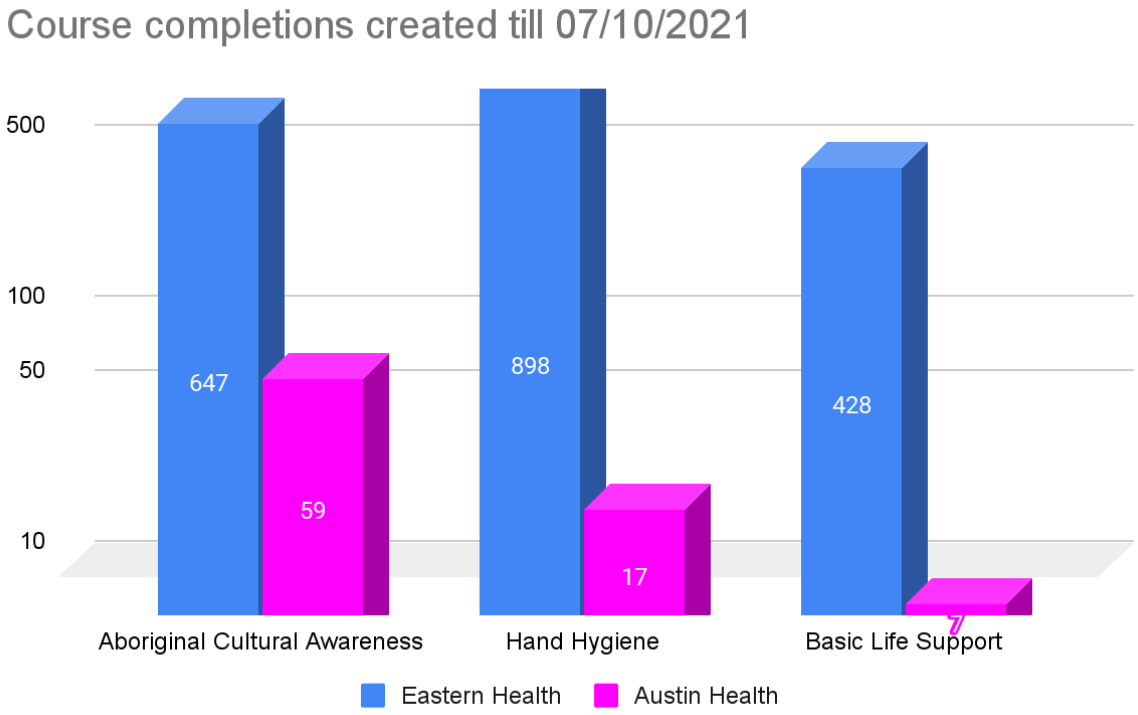
Eastern Health, Course completions exported

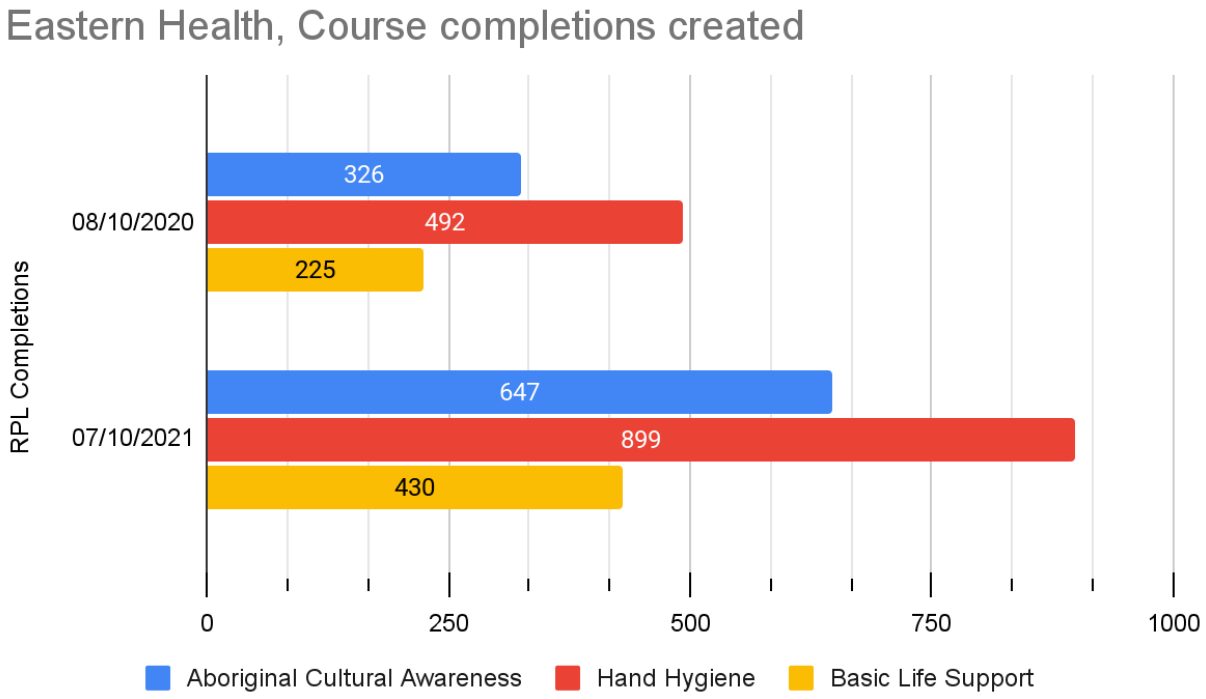


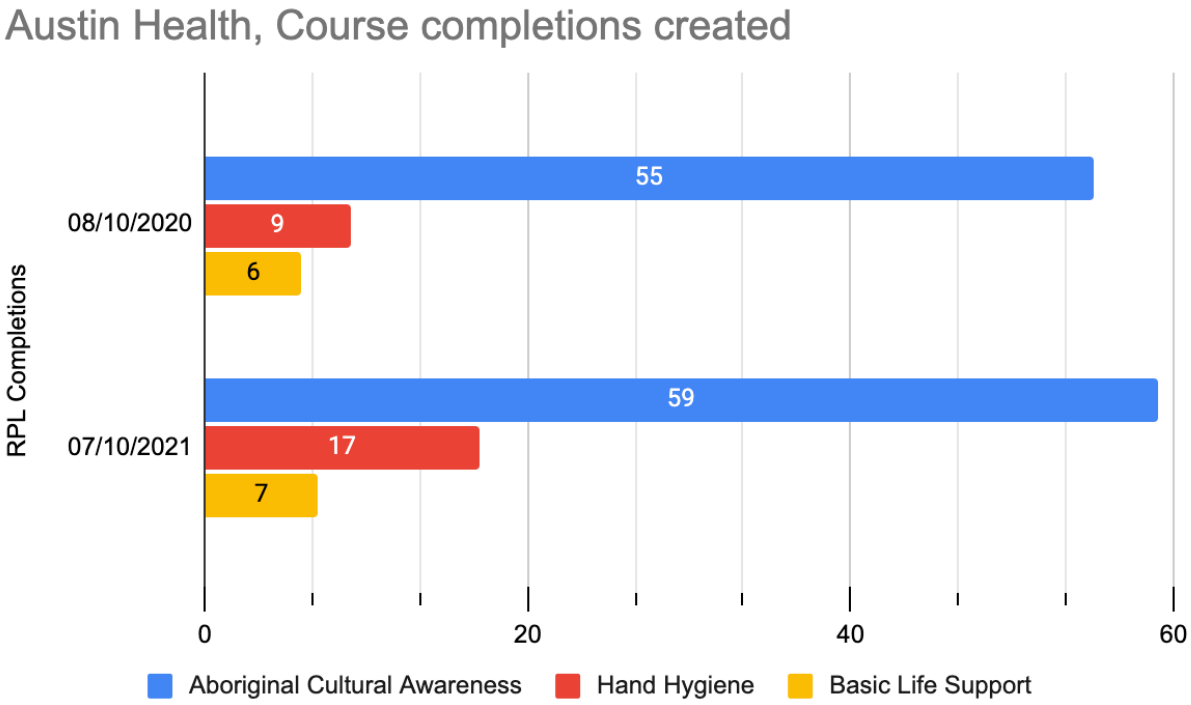
Austin Health, Course completions exported



3.3.2 Course completion records created in LMS (based on matched users)







3.3.3 Course matching & related issues

Once the courses were mapped across the institutions and matching Course Id Numbers were applied to the courses, matching was straightforward. Identified issues included however:

1. The need to map the courses and set the numbers manually (a once-off exercise)
2. Potential issues wherein a course in one institution can not be mapped to an equivalent course in another institution such as e.g. where the course includes key, localised content that must be completed.

3.4 Interview data

Full transcripts of the project participant are available in the following files:

Interviewee	Filename
Rob Lopresti, Director, Clinical Education Unit, Austin Health	*Rob Lo Presti_highlights.docx*
Dale Chadwick, Learning Technology Manager, Austin Health	*Dale_Austin_Highlighted.docx*
Peter Mellow, Director, Learning Design and Systems, Learning and Teaching Directorate, Eastern Health	*Peter_Eastern.docx*

Mathew Carson, Digital Learning Coordinator, Eastern Health	*Matthew_Eastern.docx*
Alexander Roche, Principal Educational Technologist, Androgogic	*Alexander_interview.docx*

Transcript files are shipped with this research report in the accompanying file: *MACH - Safety and Rescue Project Research Report - Participant Interview Transcripts.zip*

Key insights from the Austin Health and Eastern Health learning and development teams included amplification for the drivers behind automating the transfer of course completions including the avoidance of time spent reconciling prior learning data or unnecessary repeat training and correlating time lost to patient care.

4. Conclusions & recommendations

4.1 Course completions & potential cost benefits

Automating the transfer of course completion records is technically feasible. This could be expanded to include more participant institutions which would increase the volume as personnel move between them. A 'spoke-and-hub' LRS model also allows cost efficiencies with one system serving potentially many participating hospitals and consequent multipliers for cost benefits.

In terms of cost benefits, the current time taken to manually process a migrating staff member's RPL is 0.5 hours plus an average of an additional 10 minutes per match of LMS administration time.

If we define:

- 'A' as the average hourly wage cost to the institution of the migrating staff member
- 'B' as the hourly wage cost of the LMS administrator
- 'C' as the number users matched

This would make the cost saving equation for that period as follows:

((0.50 x A)+(0.17 x B) X C)

Average wages costs

Estimated average hourly rates for medical staff were requested from Eastern Health HR. The results from August 2021 were as follows:

- Intern: $40
- HMO: $55
- Registrar: $63
- Medical Officer: $187

This makes the estimated average hourly rate for all medical staff: $101

Based on market rates, LMS Administrator average hourly rate was estimated at $50/hour.

Calculation below take the matching results data from the project for all matched users (all time, both databases) and for completions in the last 12 months (08/10/2020-07/10/2021):

- Austin Health: C = 221 (all time), 5 (last 12 months)*
- Eastern Health: C = 1049 (all time), 191 (last 12 months)

and using sample average hour wage costs of:

- A = $101 / hour
- B = $50 / hour

Cost/time variables	
Current average time in hours for migrating employee to manually assemble RPL evidence	0.50
Average migrating employee hourly wages costs	$101.00
Time in hours for the LMS administrator to process the RPL	0.17
LMS admin hourly wage costs	$50.00
Cost per migrating employee for manually processing RPL	$58.83

Eastern Health matching	
Total EH matched users	1049
EH saving for total matched users	$61,716
Total EH matched users in the last 12 months (08/10/2020-07/10/2021)	191
EH projected annual saving	$11,237

Austin Health matching*	
Total AH matched users	143
AH saving for total matched users	$8,413
Total AH matched users in the last 12 months (08/10/2020-07/10/2021)	5

AH projected annual saving	$294

**See notes in section 3.1 regarding the researcher's concerns about the completeness of the collected AH data.*

4.2 Matching courses

Course matching was successful however the identified issues (see 3.3.2 Course matching & related issues) would need to be addressed in a broader roll out of the system. In such a broader roll out, a parallel curricula strategy would also be recommended. Specifically, if some of the skill areas addressed in mandatory training could be delivered using shared courses resources, efficiencies for content development and refreshment could be combined with streamlined course matching for cross-institutional data exchange.

Also in a broader roll out, course completion tagging could also designate from which institution the original record emanated.

4.3 Matching user records

4.3.1 Matching rules

User matching is a key issue for this kind of project but not an insurmountable one. Use of AHPRA and date of birth in addition to firstname, surname and email meant most users could be matched effectively. Not all institutions would have this data available however the project showed that it is not a difficult once-off sub-project to add the data to the feed to the LMS. If the project were to be extended into a broader phase two with more institutions, this aspect should be incorporated in the institution's scope.

4.3.2 AHPRA numbers

AHPRA numbers proved to be useful and indeed in many cases critical in the matching of users between institutions. The issues identified would need to be addressed in a broader implementation of the integration. This would include ensuring that AHPRA data is entered into the institution's Human Resources Information System or other key user records system such as Payroll, etc. Further, in the research project, only one AHPRA number was used for matching. Further development on the matching tools could be done to ensure matching is conducted on multiple numbers where relevant (clinicians with multiple roles can have multiple AHPRA numbers).

In a broader roll out of the system, the software should also be improved to effectively match on more than one AHPRA number.

A further recommendation is to examine the integration of the LRS with the AHPRA registry using the 'Data Partner' program offered by AHPRA. This program has set up costs, licence and

usage costs. If the connection was to one LRS for all participating hospitals, the costs would be streamlined.

Such an integration could be used to validate a user and potentially to also retrieve their AHPRA number where not yet present in the institution's corporate systems.

A further use of the integration would be to allow an automated, annual check on registration status which would be of benefit to participating institutions which do this check manually at the present time.

4.3.3 User opt-in/out

It would be possible to develop an opt-in or opt-out component to the integration. The LRS API could be configured to receive this data from e.g the participating institution's LMS or other system.

It could also be incorporated into an App for use by Healthcare professionals. Users could be empowered to push their data to a new institution, choosing from a list of participating hospitals. This could potentially also be extended to include CPD data and connections to key CPD administrating bodies such as the Royal Colleges, the Pharmacy Guild, etc.

4.4 Insights from the participant interviews

The positivity for the outcomes of the project was clearly visible in the interview transcripts. This suggests that a broader roll out of this system would be positively received by learning and development teams in other hospitals and by extension by clinical and non-clinical personnel.

A further insight from the interviews was reference to the proactive value of cross-institutional collaboration in terms of learning and development. This is seen as very valuable but has been, e.g. according to Peter Melow, *"very informal and spasmodic"*. A broader rollout of this system could be used to formalise and strengthen cross-institutional sharing of learning and development resources and expertise.

4.5 Possible next phase roll out

4.5.1 Deployment to a wider set of participating institutions

In addition to the use of a standards-based approach to integration using xAPI, the Androgogic technology used in the research project with the LMSs would be relatively easily deployed to other public Healthcare institutions using the Totara LMS. In Victoria these include:

- Alfred Health
- Ambulance Victoria
- Austin Health
- Ballarat Health

- Bendigo Health
- East Grampians Health Service
- Eastern Health
- Goulburn Valley Health
- Northern Health
- Peninsula Health
- Peter MacCallum Cancer Centre
- Royal Children's Hospital, Melbourne
- Royal Melbourne Hospital
- Royal Womens Hospital
- South West Alliance of Rural Health
- Western Health

Using the data collected in the project including the average number of matches of migration personnel per month for Eastern Health and the sample wage cost values, the potential saving per month for the set of 16 institutions above would be:

Phase 2 expanded roll out matching	
Number of participant hospitals in phase 2	16
Total projected matched users per year in phase 2	3056
Total annual saving phase 2 across 16 participating hospitals	**$179,795**

Eastern Health has one of the larger populations of Healthcare professionals on the 16 so the projected number of annual matched users may be slightly lower than the above. However, it is also anticipated that matching numbers can be increased through refinements in the integration software stemming from lessons learned in the project.

4.5.2 Non-Totara LMS integration using xAPI

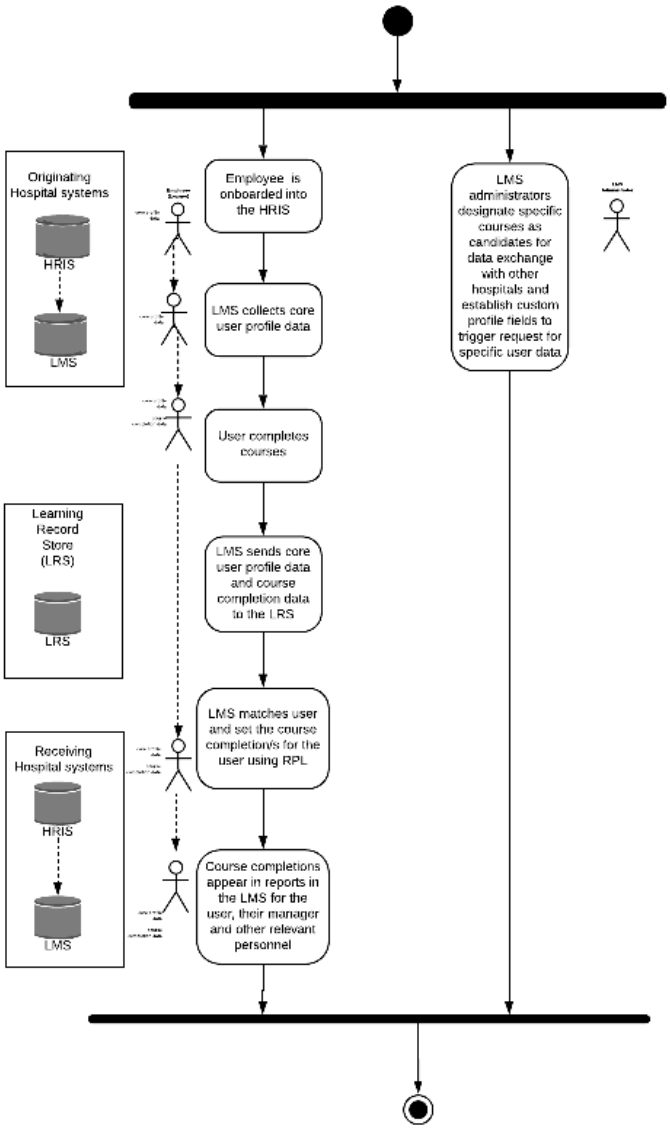
To test the use of xAPI with a non-Totara LMS, it would be good to include at least one other institution in addition to the above. A very good candidate would be Hand Hygiene Australia (HHA) which uses the Janison LMS which is a mature LMS and can be expected to support xAPI.

Integrating with HHA would achieve more than testing the hypothesis that a standards-based approach reduces vendor specificity. Many of the above institutions send personnel to Hand Hygiene's LMS for completion of one or more of the Hand Hygiene courses. This is mostly done by directing their staff to HHA's LMS where they register, often using details that do not match those in the institution's own LMS which makes the matching of completion records difficult when retrieved from HHA.

Many of the hospitals require their staff to return to the institution's LMS and upload certificates to prove they have completed the HHA course/s.

Using the xAPI integration with the LRS and course completion records transfer, it would be possible to automate both the registration of the personnel by role into the relevant course and also to return their completion data without user effort or intervention. This automation would eliminate another known efficiency headache for the participating institutions.

Appendix A: User data & data workflow



Appendix B: Interview instrumentation

B.1 Survey for Androgogic

Construct	Questions	Probes	Outcome
Role in Facility	First, I would like to ask you a few questions to help me understand your role in your facility and the S&R program.		
Role in Facility	What is your title? What are your main responsibilities?		
Intervention Source	How did Androgogic become involved with S&R?	How was the decision made to participate in S&R? Who participated in the decision-making process?	Appropriateness
Engaging	How did you personally get involved?	Ask about decision process- about perception of how decision was made to involve him/her.	Appropriateness
Evidence Strength & Quality	What kind of information or evidence were you made aware of to show whether the S&R program would work?	Information from your own experience, published literature, or other sources? From co-workers? From supervisors? To what degree did this evidence influence your opinion of S&R before it was implemented?	Appropriateness

Tension for Change	Do/did you see a need for this type of intervention? Why or why not?	Did other people feel it was needed?	Appropriateness
Characteristics of individuals; Organizational Incentives & Rewards	What has motivated you to get S&R off the ground?	Will you be evaluated on how the program goes?	
Compatibility	Roughly how much time was required to develop this software?		Feasibility
	How well does S&R fit (integrate/interface) with the other hospital programs?		Feasibility
Characteristics of individuals	Do you feel ethically conflicted with using S&R? (privacy concerns).		Acceptability - ethicality
Characteristics of individuals	How positive has your attitude been towards the process of implementing S&R?		Acceptability - Attitude
	On a scale of 1 to 10, 1 = low and 10 = high, how supportive of this project were the senior managers (Rob and Peter) at the hospital to help implement S&R? Why did you give this rating?		Readiness assessment
	On a scale of 1 to 10, 1 = low and 10 = high, how willing were the hospital staff to trial the new software? (Dale and Matt) Why did you give this rating?		Readiness assessment

Process - Executing	What activities have been done to get S&R implemented? When/milestones? Who has been involved?	How did you track what tasks needed to be done? Progress? Status?	
Networks & Communication	What plans did you put in place to ensure successful implementation of the new software?		Readiness assessment
Available resources	What training did you offer the hospital staff during the early implementation phase?	What ongoing training are you offering the hospital staff to help run the new software?	Readiness assessment
	Were the financial resources for the development of S&R adequate?		Readiness assessment
	Are the financial resources for the ongoing costs to run S&R adequate?		Readiness assessment
Patient Needs & Resources	How well do you think S&R meets the needs of clinical staff?	Which process do you prefer and why?	Acceptability – perceived effect
Implementation Effectiveness	On a scale of 0-10, how successful do you think piloting S&R at your site is going/has gone? Why? 0 is complete failure 10 is I can't imagine how it could be any more successful.	Note: We are interested in the "perception" of success; the interviewee can define success in any way.	
Complexity	And now, summing up your implementation experience thus far: On a scale of 0-10, how difficult has it been to implement S&R? Why? 0 is easy		

	(no difficulties) 10 (extremely difficult; it couldn't get any more difficult)	
	What are the main barriers Androgogic has needed to overcome to implement S&R software?	Feasibility
	What are facilitators or enablers that have helped Androgogic deliver S&R?	Feasibility
Implementation Effectiveness	Based on your experiences with S&R, would you recommend continuing S&R at the hospitals? Why or why not?	

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