
Enhancing Hawaii Hospital Information Content (eHHIC)

Deliverable 3:

High-Level Analysis of Transmitted Laboratory Data

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I. Objective

To construct a standardized, high-quality clinical dataset consisting of laboratory test values from 19 participating hospitals which will be linked with hospital inpatient discharge data from CY2008-2011.

A. Data standardization

1. LOINC
2. Facility ID
3. Blood Gases
4. HL7 format

B. Data quality

1. Discharge Dates
2. Account and Medical Record Differences

II. Method

HHIC initially supplied all participating laboratory data providers with data specifications that would allow for receipt of high-quality data standardized across all data providers. Some data providers would have required extension of the specified time frame to fully conform to the requested data specifications; while several facilities faced such large resource constraints that they could not conform to the specified data format altogether. To minimize resource utilization by data providers and to stay within the project time frame, HHIC relaxed the data specification requirement and instead accepted transmissions that were largely facility-specific. As a result, HHIC had to evaluate all transmitted data to ensure that they met the initial formatting, quality and completeness requirements.

All non-federal acute care hospitals in Hawaii were invited to participate in this study. Of the 24 invited hospitals, 19 hospitals participated in the study.¹

As of September 27, 2012, a total of 30,668,969 laboratory records from 2008 to 2011 were received from the 19 participating facilities.

A. Data Standardization

1. LOINC

Logical Observation Identifiers Names and Codes (LOINC) are the universal standard for identifying medical laboratory observations. Because LOINC is increasingly accepted by laboratories, we requested that each provider use LOINC for the transmitted lab data. However, we discovered in our early interviews that not all lab tests have been converted to a standard LOINC. As a result, we initiated discussions with the two main laboratories and agreed upon specific LOINC codes to be used for the 32 requested lab tests (Appendix A).

Although the laboratories had the capability to transmit the LOINC code within the lab message, the “in-house” labs were not as familiar with the LOINC standard and were unable to send the LOINC code. For these labs, HHIC created a LOINC crosswalk to map the facilities’ “local test code” to the appropriate LOINC standard.²

¹ See Deliverable 1 for more detail on hospital participation.

² The crosswalk was approved by each provider.

2. Facility ID Standardization

The Facility ID listed in the lab results differed from the Facility ID present in the HHIC discharge database. As a result, HHIC established a Master Facility ID and created a crosswalk used to link the lab data to the discharge record.

3. Blood Gases

While HHIC's initial strategy was to receive lab data for seventeen facilities from the two main laboratories in the State, through discussions with the labs, it was noted that seven out of these seventeen hospitals perform and report their own blood gases due to the sensitivity and timing of the test.

Blood Gases(pO₂, pCO₂, pH, Base Excess and Bicarbonate) are significant to the study as they have been proven through peer reviewed literature (McCullough, 2011) to be important predictors of inpatient mortality and complications based on adjustment of patient level All-Patient Refined Diagnosis Related Groups(APRDRGs) risk of mortality (ROM) scores.

As a result, additional agreements needed to be established with seven hospitals to extract and provide their blood gas data for the study. Transmitting the blood gas data from these individual facilities was not without challenges. Separate data extracts needed to be created and additional electronic interfaces needed to be implemented. One facility was unable to provide blood gas data for the entire study period due to the lack of an electronic interface. Because of the small volume of annual discharges (approximately 1,262 discharge records out of a total of 135,000 approximate discharge records per year), the exclusion of the blood gas data for this facility did not have a significant impact on the study.

3. HL7 Formatting

HHIC initially requested laboratory data be submitted via HL7 v2.5.1, the standard method for exchanging, managing and integrating healthcare information from one system to another. Both historical and "live" (current) lab data were requested from each facility to cover the study period (CY 2008-2011). However, because some facilities were unable to transmit lab data in this format, we allowed facilities to submit data in the formats described below.

a. Live Lab Data

Of the 19 participating facilities, all except one transmitted live laboratory results via multiple HL7 versions. To standardize the HL7 messages to the most current HL7 version (v.2.5.1), HHIC mapped prior HL7 versions (v2.3) to the current version using our HL7 transformation tool.

b. Historical Lab Data

Submitting historical data via HL7 presented additional challenges, as it was resource intensive for majority of the facilities and for many (18) was programmatically unmanageable due to the way the data were stored. The facilities requested to submit the data in American Standard Code for Information Interchange (ASCII) format. To maintain data standardization, HHIC distributed ASCII file data specifications that were equivalent to the HL7 data specifications. The ASCII files were then mapped to the appropriate HL7 message segment within HHIC’s HL7 transformation tool.

c. Blood Gases

Seven hospitals performed and reported their own blood gas tests. Due to system and reporting capabilities, various data formats were received for these tests. These included ASCII files, HL7 transmissions and SQL database extracts. These files were processed and formatted by HHIC to meet HHIC’s standardization requirements.

A complete listing of lab reporting format by facility is found in Appendix B.

B. Missing Laboratory Data

Four hospitals were unable to provide blood gas data for specific time periods due to the transition of implementing an Electronic Medical Record system (EMRs).

The chart listed below details the hospitals and time frame of the missing data.

Hospital	Data Elements	Time Period
Pali Momi [†]	All Blood Gases	Jan 2008 - Apr 6, 2008
Kapiolani Womens & Children [†]	All Blood Gases	Jan 2008 – Nov 8, 2008
Maui Memorial	All Blood Gases	Jan 2008 – Apr 2008 Jan 2009 – Aug 2009
Wilcox [†]	All Blood Gases	Jan 26, 2011 – Aug 3, 2011

* Hospitals are part of the same hospital system, Hawaii Pacific Health (HPH), and utilize the same lab reporting software.

C. *Data Quality*

Several data issues were discovered and needed to be resolved before moving forward with the linking of the datasets.

1. Discharge Dates

Discharge dates from the lab results were incomplete across all facilities. One of the laboratories was unable to provide the discharge date for two facilities (Molokai and The Queens Medical Center) historical data. Understandably, 'live' or current lab data transmissions also did not include the discharge date. Although .12% of the total records submitted contained a blank observation date, the observation date was submitted more consistently and was therefore used as a key matching variable when linking the lab records to the appropriate discharge record.

2. Account and Medical Record Number differences

Preliminary analysis showed that two key linking variables (account number and medical record number) submitted in the lab data for two facilities differed from the values present in HHIC's discharge data and prevented the linking of the lab data to the hospitalization discharge record for these two facilities.

One facility's electronic medical record system (EMR) generated two "hospital account numbers". The account number provided in HHIC's discharge dataset is the hospital billing number while the account number provided in the laboratory data is one specific to the patient's visit. A point of contact was established with this facility to assist with creating a crosswalk between the two account numbers for linking purposes.

Through discussion with the laboratories, it was determined that one hospital system submitted the medical record number to the lab in a position within the HL7 message that is outside the norm. This resulted in the laboratory modifying their lab extract to supply the correct medical record number.

III. Conclusion

Although predefined data specifications were provided to all facilities to aid in the preparation of laboratory data files, it was important for HHIC to remain flexible regarding the types of data that were received and how they were transmitted in order to sustain facility participation in the study. Of equal importance was the allocation of additional time, effort and resources to adjust for data inconsistencies across all facilities through use of crosswalks, standardization and formatting. These were two crucial components of the process that produced a high-quality laboratory dataset to link to HHIC's Inpatient discharge data.

IV. Signatures

Prepared by: _____

Position Title: _____

Date: _____

Approvals:

Project Manager: _____

Date: _____

Co-Principal Investigator: _____

Date: _____

Appendix A: Summary of 32 Requested Lab Tests

	Lab Test	Lab Test Name	LOINC	Units	LOINC SHORTNAME
Chemistry	Albumin	Albumin	1751-7	g/dL	Albumin SerPI-mCnc
	Alkaline phosphatase	Alkaline phosphatase	6768-6	U/L;units/L	ALP SerPI-cCnc
	Blood urea nitrogen (BUN)	Urea nitrogen	3094-0	mg/dL	BUN SerPI-mCnc
	Bilirubin (total)	Bilirubin	1975-2	mg/dL	Bilirub SerPI-mCnc
	Calcium	Calcium	17861-6	mg/dL	Calcium SerPI-mCnc
	Chloride	Chloride	2075-0	mmol/L	Chloride SerPI-sCnc
	Creatine kinase-MB	Creatine kinase.MB	13969-1	ng/mL; ug/L	CK MB SerPI-mCnc
	Creatinine	Creatinine	2160-0	mg/dL	Creat SerPI-mCnc
	Glucose	Glucose	2345-7	mg/dL	Glucose SerPI-mCnc
	Gamma glutamyl transferase	Gamma glutamyl transferase	2324-2	U/L;units/L	GGT SerPI-cCnc
	Potassium	Potassium	2823-3	mmol/L	Potassium SerPI-sCnc
	Phosphate	Phosphate	2777-1	mg/dL	Phosphate SerPI-mCnc
	BNP	Natriuretic peptide.B	30934-4	pg/mL	BNP SerPI-mCnc
	Sodium	Sodium	2951-2	mmol/L	Sodium SerPI-sCnc
	Troponin I	Troponin I.cardiac	10839-9	ug/L;ng/mL	Troponin I SerPI-mCnc
	SGOT	Aspartate aminotransferase	1920-8	U/L;units/L	AST SerPI-cCnc
	SGPT	Alanine aminotransferase	1742-6	U/L;units/L	ALT SerPI-cCnc
Blood Gas	pO2	Oxygen	2703-7	mm Hg	pO2 BldA
	pCO2	Carbon dioxide	2019-8	mm Hg	pCO2 BldA
	pH	pH	2744-1		pH BldA
	Base excess	Base excess	1925-7	mmol/L	Base excess BldA-sCnc
	Bicarbonate	Bicarbonate	1960-4	mmol/L	HCO3 BldA-sCnc
Hematology	Hemoglobin	Hemoglobin	718-7	g/dL	Hgb Bld-mCnc
	Hematocrit	Hematocrit	4544-3	L/L;%	Hct Fr Bld Auto
	Partial thromboplastin time (PTT)	Coagulation surface induced	14979-9	Sec	aPTT Time PPP
	Prothrombin time (PT)	Coagulation tissue factor induced	5902-2	Sec	PT Time PPP
	INR	Coagulation tissue factor induced.INR	34714-6	INR(POC)	INR PPP
	Platelet count	Platelets	777-3	10 ⁹ /L	Platelet # Bld Auto
	White blood count (WBC)	Leukocytes	6690-2	10 ³ /uL	WBC # Bld Auto
Micro-biology	Blood culture	Blood Culture	600-7	N/A	
	Urine culture	Urine Culture	630-4	N/A	
	Sputum culture	Sputum Culture	6460-0	N/A	

Appendix B: Data Transmission Format, by Facility

Facility	Reporting Lab [†]	LIVE Data		Historical Data		Note
		Blood Gases	All Other Labs	Blood Gases	All Other Labs	
Castle	In House/DLS	HL7	HL7	ASCII	ASCII	DLS provides Microbiology Labs
Hamakua	CLH	HL7	HL7	ASCII	ASCII	
HMC – East	CLH	HL7 [§]	HL7	SQL [§]	ASCII	
HMC – West	CLH	HL7 [§]	HL7	SQL [§]	ASCII	
Hilo	CLH	HL7	HL7	ASCII	ASCII	
Kaiser	In-House	ASCII	ASCII	ASCII	ASCII	
Kapiolani	CLH	HL7 [§]	HL7	ASCII [§]	ASCII	
Pali Momi	CLH	HL7 [§]	HL7	ASCII [§]	ASCII	
Kohala	CLH	HL7	HL7	ASCII	ASCII	
Ka’u	CLH	N/A	HL7	N/A	ASCII	
Kula	CLH	N/A	HL7	N/A	ASCII	
Kauai Veterans	CLH	Manual	HL7	Manual	ASCII	Blood Gases not supplied due to no electronic interface
Maui	CLH	HL7 [§]	HL7	HL7 [§]	ASCII	
Molokai	DLS	HL7	HL7	N/A	HL7	
North Hawaii	CLH	HL7	HL7	ASCII	ASCII	
Kona	CLH	HL7	HL7	ASCII	ASCII	
Straub	CLH	HL7 [§]	HL7	ASCII [§]	ASCII	
Queens	DLS	HL7	HL7	HL7	HL7	
Wilcox	CLH	HL7 [§]	HL7	ASCII [§]	ASCII	

[†] Unless otherwise noted above, hospital laboratory data were submitted by one of the two main laboratories in the State of Hawaii - Clinical Laboratories of Hawaii (CLH) or Diagnostic Laboratory Services (DLS).

[§] Blood gas results provided directly by hospital, independently from reporting lab.

