Whither Standards? Barcoding and Data Interoperability in the NAHLN

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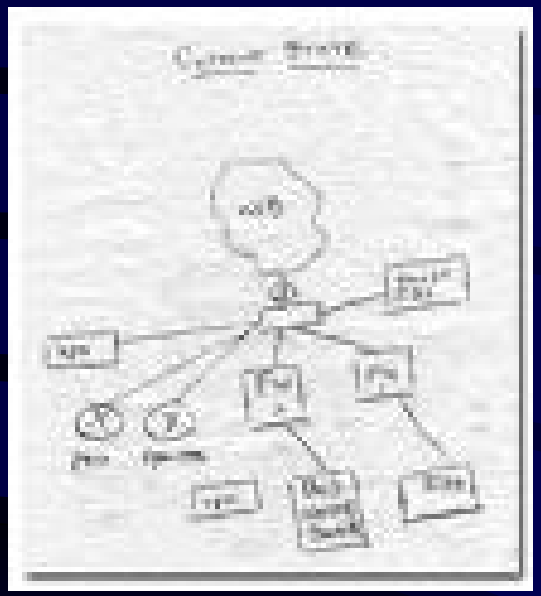
In the Beginning...
AAVLD 2000



AAVLD IT representatives met informally with CSREES to discuss an initial architecture:

- Secure
- Standards based
- Platform independent
- Centralized administration

Overarching Principles of the NAHLN IT Architecture

- The overall goal of electronic laboratory reporting is that it is a by-product of normal laboratory operation.
- Regardless of the animal disease program involved, all laboratory result data are transmitted to a central data repository.
- Specific disease program public reporting requirements are the responsibility of the USDA program staff, not the laboratory.

Specific Goals of NAHLN IT

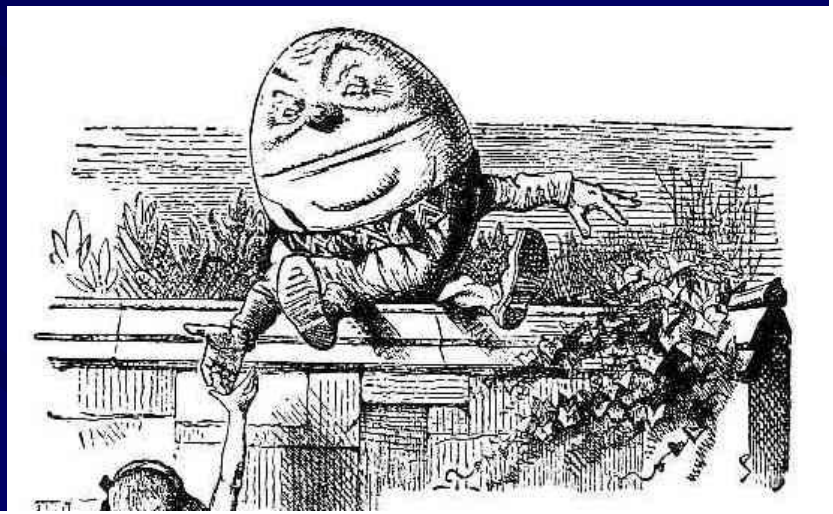
- Improve speed of reporting through electronic exchange of standardized laboratory data
- Decrease errors and improve data quality through the reduction of manual data entry
- Incorporate the use of globally unique, machine readable identifiers (barcodes)
- Provide standardized data structures to allow for data reuse

Setting the stage

'When I use a word,' Humpty Dumpty said, in a rather scornful tone, ' it means just what I choose it to mean, neither more nor less.'

'The question is,' said Alice, 'whether you can make words mean so many different things.'

'The question is,' said Humpty Dumpty, 'which is to be master - that's all.'



The Case for Standards

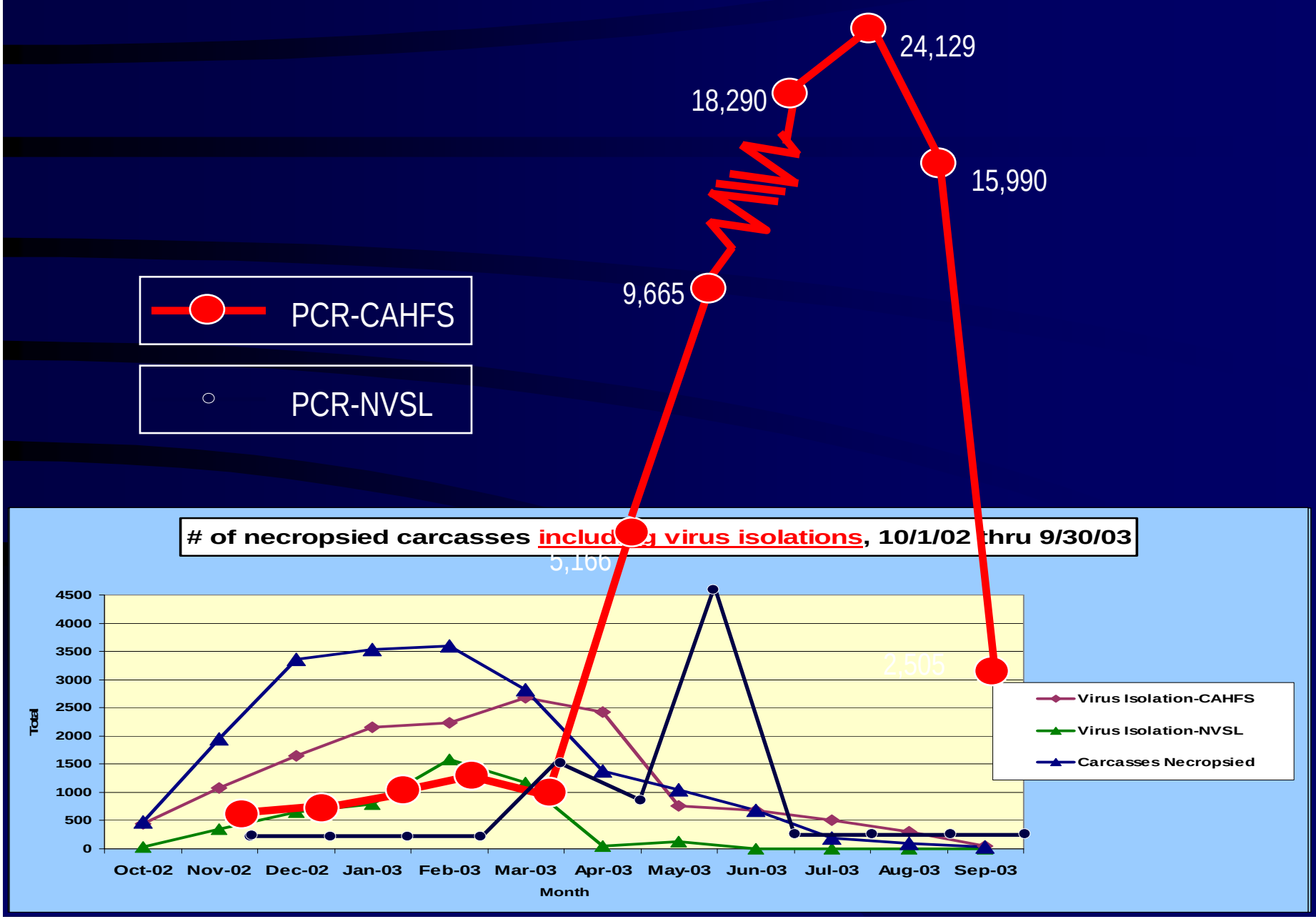
"Within one laboratory, local jargon terms may be used which are usually well understood between colleagues, but would not be sufficiently widely known for communication with the outside world."

U. Forsum et al., Pure Appl. Chem 72:555-745, 2000 *Properties and Units in the Clinical Laboratory Sciences Part VII. Properties and Units in Clinical Microbiology*

Standards Foundation

- Accepted international standards selected
  - Health Level Seven
    - Message structure and format
  - SNOMED - Central reference terminology
    - Taxonomy
    - Specimen Types
  - LOINC
    - Laboratory order and result names and identifiers
  - Unique Identifiers
    - ISO OIDs standard for unique identifiers
    - NAIS Animal Identification (“840”) Numbers
    - Specimen Barcode IDs (centrally Assigned)

Then Came END...



come to UC Davis

The “Pilot Project”

- The END outbreak underscored the need for more automated methods of sample and data handling
- Small scale cooperative project developed as proof of concept
  - “Barcoding project”
  - “Field sample and data collection project”
  - “California Pilot Project”
- Field to Final Report electronic sample tracking

Information Flow used for all surveillance/monitoring programs (past and present)

Samples are collected in the field, the data for the samples are recorded into piece of paper, which is transcribed into we website.

Barcoding technology is utilized to provide rapid identification of samples, and to reduce manual data entry errors.

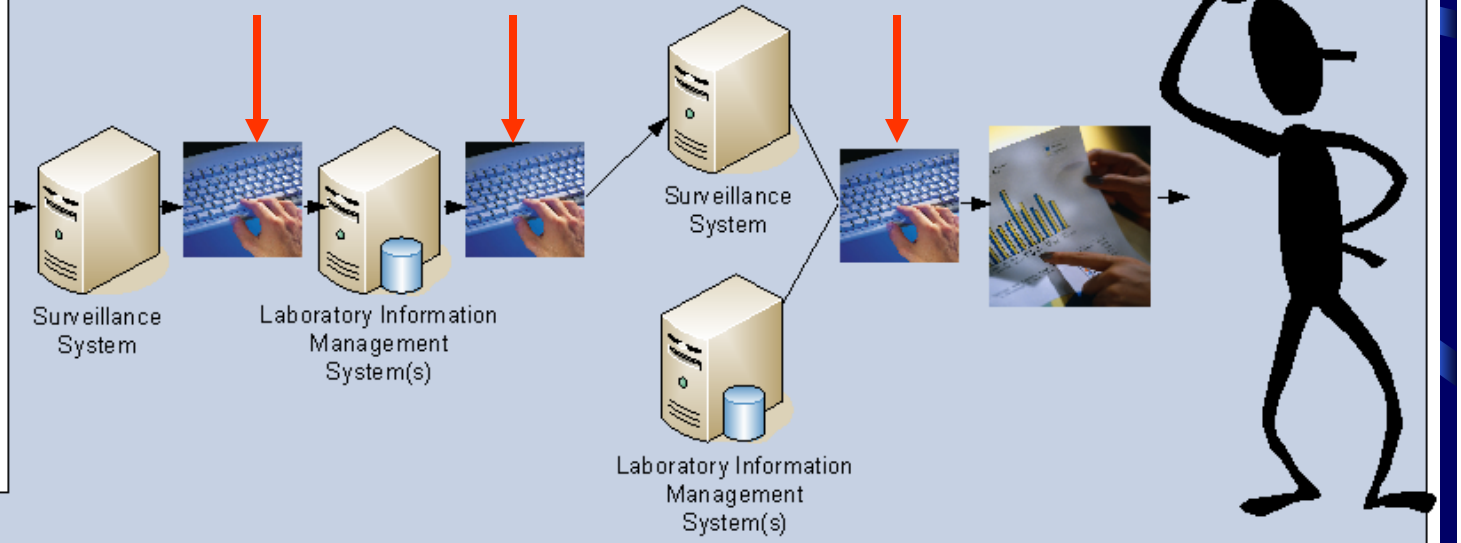
The data collected is stored.

Samples arrive at Laboratory and are hand entered into the lab information system

Once result data is available, the laboratory technicians hand enter results back into the surveillance system via a website (Note: passive surveillance/ monitoring data is not captured)

Reports are generated from the surveillance system, but must be hand compared and tallied against lab data and passive surveillance of monitoring efforts (note, reports generated by hand often have a 30%+ error rate)

Due to the nature of how the data is compiled, the figures are often questioned.



Note how the information flow is non-integrated, all steps require manually entry.

Information Flow Introduced with the Pilot Project

Samples are collected in the field.

Barcoding technology is utilized to provide rapid identification of samples, to reduce any data entry errors, and to facilitate the matching of the electronic information to the samples

The field tablet or laptop sends the data to a central server

The data router and validator retrieves the data from the field data server, and forwards it the appropriate system(s)

The program mangers have the field data data, and the laboratory receives the test orders.

The same mechanism is utilized to send the test results from the laboratory to the program data collection system

Reports are Generated from the main surveillance system with no manual steps.

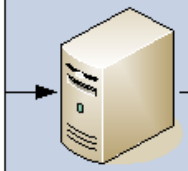
The data is immediately usable to make decisions, and is accurate.

Action is taken from the data produced for the reports

Monitoring shows increasing trend, and warrants action

Surveillance produces a reaction, thus triggering an emergency response

Emergency response produces a reaction, which warrants action for the affected region



Field Data Collection Server

Data Router And Validation

Program Data Collection System

Laboratory Information Management System

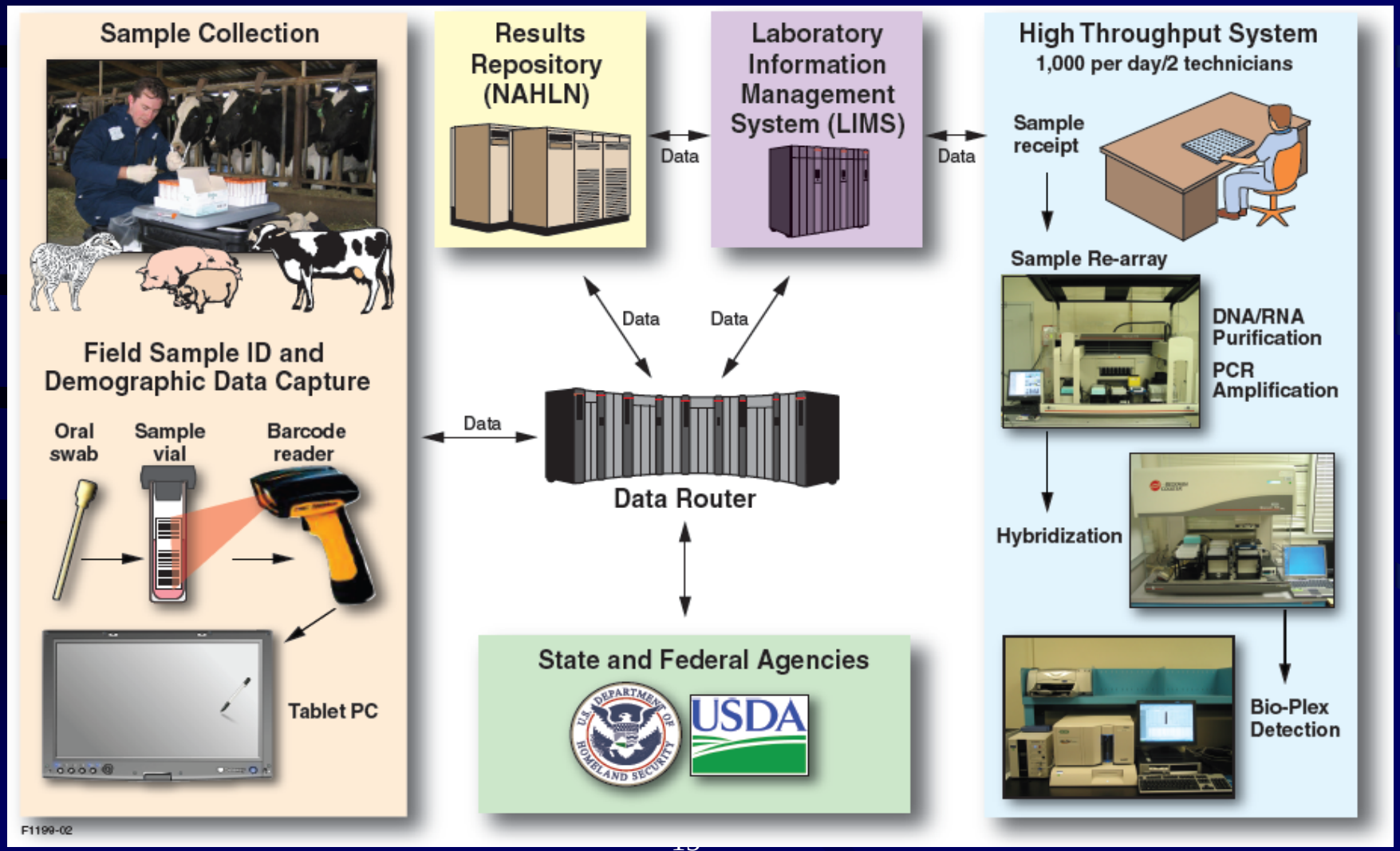
The Next Step - AgDDAP

- Agricultural Security Domestic Demonstration and Application Program
- Funded by the US Department of Homeland Security
- In collaboration with the USDA APHIS National Animal Health Laboratory Network (NAHLN) and Lawrence Livermore National Laboratory

Pilot Project Success Applied to High Throughput Demonstration Project

- Field sample identification and data collection
  - Leverages technology developed by USDA APHIS CA Pilot Project
    - Adaptation support from USDA APHIS NAHLN, CA and CO IS/IT teams
  - Electronic transmission of data to laboratory and end user's database
- Bio-Plex data analysis
  - Data interpretation using LLNL developed algorithm
  - Interpretation occurs at Lab
  - 17 simultaneous detections per specimen
- Results reporting
  - Lab LIMS to send interpretation to NAHLN repository for re-association with demographic data

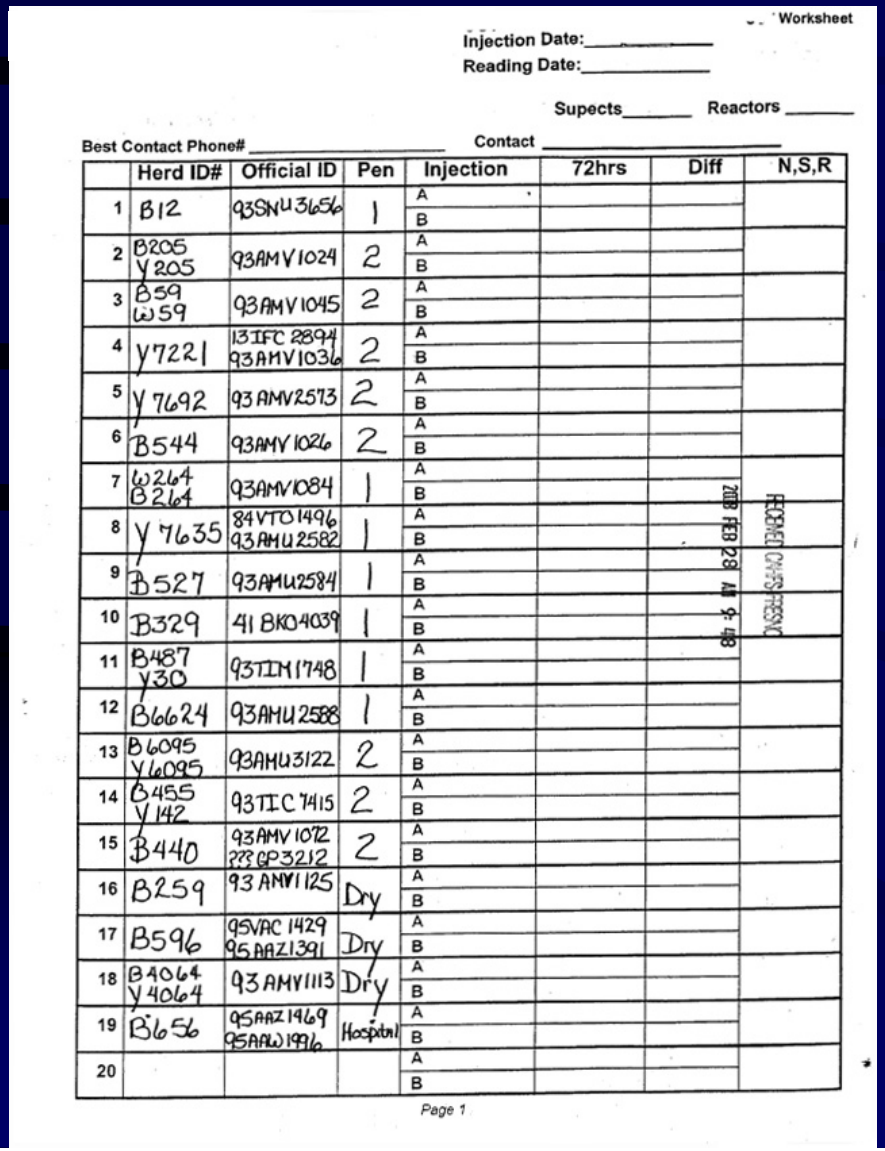
NAHLN High Throughput Pilot Demonstration Project



Application of Pilot Project NAHLN concepts to CA Bovine Tuberculosis

- Bovine Tuberculosis identified in CA December 2007
- More than 5400 cattle samples submitted for gamma interferon testing
- All specimens submitted with unique, centrally generated barcode identifier
- Barcodes linked to NAIS RFID in the field
  - Producer IDs also captured
- Linkage data transmitted electronically to USDA and CDFA.
- Laboratory results transmitted to CDFA via NAHLN defined message structures

Initial Sample Submissions



Worksheet

Injection Date:_____

Reading Date:_____

Supects_____ Reactors _____

Best Contact Phone# _____ Contact _____

	Herd ID#	Official ID	Pen	Injection	72hrs	Diff	N,S,R
1	B12	93SNU3656	1	A / B			
2	B205 Y205	93AMV1024	2	A / B			
3	B59 W59	93AMV1045	2	A / B			
4	Y7221	13IFC2894 93AMV1036	2	A / B			
5	Y7692	93AMV2573	2	A / B			
6	B544	93AMV1026	2	A / B			
7	W264 B264	93AMV1084	1	A / B			
8	Y7635	84VTO1496 93AMU2582	1	A / B			
9	B527	93AMU2584	1	A / B			
10	B329	41BKO4039	1	A / B			
11	B487 Y30	93TIM1748	1	A / B			
12	B6624	93AMU2588	1	A / B			
13	B6095 Y6095	93AMU3122	2	A / B			
14	B455 Y142	93TIC7415	2	A / B			
15	B440	93AMV1072 ???GP3212	2	A / B			
16	B259	93AMV1125	Dry	A / B			
17	B596	95VAC1429 95AAZ1391	Dry	A / B			
18	B4064 Y4064	93AMV1113	Dry	A / B			
19	B656	95AAZ1969 95AAW1996	Hospital	A / B			
20				A / B			

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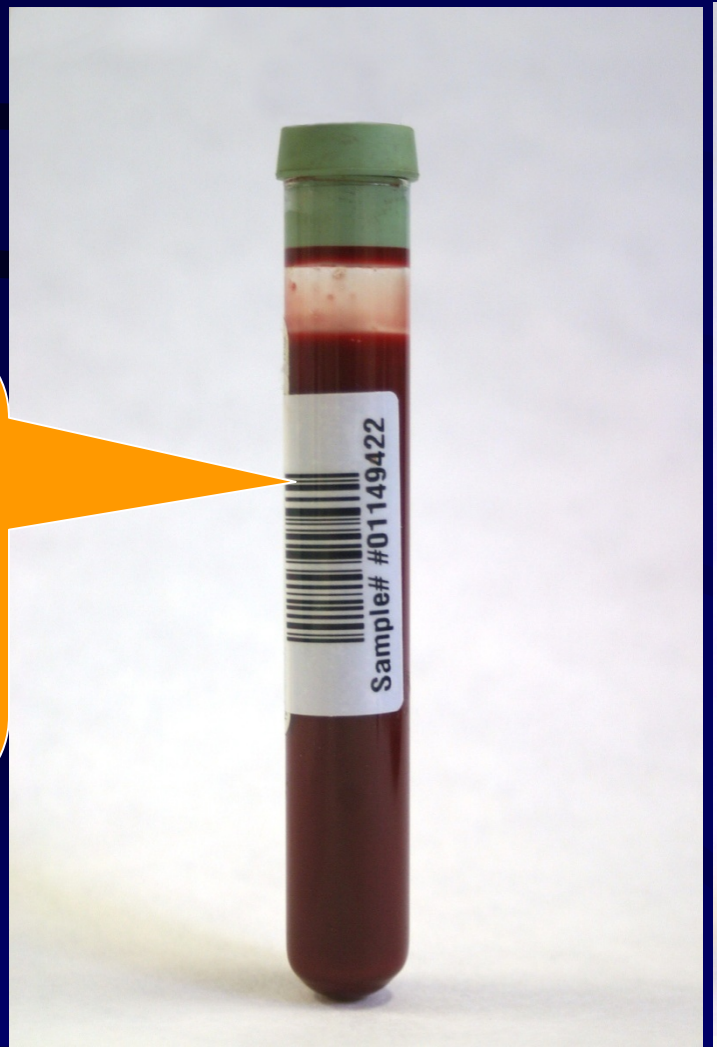
Page 1

Issues with manual data collection

- Illegibility of handwritten IDs
- Non-uniqueness of local herd IDs (i.e. ear tags, bangles, etc.)
- Transposition of long official IDs
- Requirement for redundant data entry at lab

Barcoded Sample Submissions

Field assigned barcode electronically matched to NAIS AIN RFID



Internal lab tracking number tied to field assigned barcode

Impact of Barcoding for TB on Diagnostic Laboratory Operations

- Reduced time for initial data entry
  - Time savings of up to 90%
- Elimination of transcription errors
- Automated linkage of specimen ID to the specimen source (NAIS RFID)
- Automated identification of labeling errors
  - Duplicate specimen IDs not allowed
- Reduced amount of data collected
- Ability to automate results reporting

Conclusions

- Initial concepts of the NAHLN architecture have been applied in a wide variety of scenarios
- The robust nature of the NAHLN messaging and vocabulary infrastructure supports maximal reuse with minimal retooling
- Unique specimen identifiers and field data collection tools significantly increases data quality
- The use of standardized results terminology allows for immediate data analysis

Future Goals

- Work with existing and future APHIS programs to adopt NAHLN-based standards
- Increase participation of NAHLN laboratories in messaging through training and support
- Extend NAHLN standards to additional diseases
- Develop a long-range plan for a surveillance architecture that embraces the successes of the pilot projects