EHDI program considerations for leveraging artificial intelligence/ machine learning

Initiatives to improve timeliness and reduce lost documentation

March 9, 2025

PHII PUBLIC HEALTH INFORMATICS INSTITUTE | THE TASK FORCE FOR GLOBAL HEALTH

Disclaimer

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Agenda

- Introductions
- Background
- Why AI/ML projects
- Results of Proof of Concept
- AI/ML considerations
- Questions

Presenters

Lura Daussat – Public Health Informatics Institute

Tonny Bogere – Public Health Informatics Institute

Problem statement

- EHDI programs rely on audiology providers to track and ensure deaf or hard-of-hearing infants receive diagnostic exams and are connected to early intervention services.
- Under-reporting occurs due to the manual and often duplicative data entry of reports into EHDI Information Systems.
- Jurisdictions seek innovative solutions to streamline this process.

Current state of audiology reporting

Yoda Ear Center • Audiology Department
123 Sesamee Lane, Galaxy City, DK 01427 #S31
754-139-8675 Fax 754-139-5309

Patient Name: Heather Hippo
Date of Birth: 9/15/2022
Date of evaluation: 12/7/2022
Referring Provider: Robbins, Arizona, MD

Medical Record #: 7536984126
Age: 2 m.o.
Patient Type: Outpatient
Audiologist: Lucy Brown, AuD

Audiology Evaluation: Non-Sedated Auditory Brainstem Response Evaluation (ABR)

HISTORY:
- Referred for an auditory brainstem evaluation following referred newborn hearing screen
- Birth Hospital: Seattle Grace Hospital
- Newborn Hearing Screening: Referred using OAEs, left ear x2 Passed right
- Paternal uncle, grandfather and great grandfather have a hearing loss
- Per mom, hearing loss is in the family
- Previous testing on 11/4/22 obtained present emissions right ear, absent cochlear emissions in the left ear
- AABR- pass right ear and refer left ear

IMPRESSIONS:
- **Right:** normal tympanogram with present cochlear emissions and ABR toneburst in the normal range for select tones.
- **Left:** normal tympanogram with absent cochlear emissions and ABR toneburst in the mild-moderate range consistent with a sensory hearing loss

RECOMMENDATIONS:
- Repeat ABR to further define hearing and to verify thresholds
- Otologic consultation with ENT secondary to newly identified hearing loss and to obtain medical clearance for amplification
- Hearing aid consultation, can be scheduled same day as repeat testing
- Referral to genetics to discuss/evaluate the potential for genetic etiology for hearing loss
- Recommended attending Yoda Ear Center's Deaf and Hard of Hearing (DHH) clinic which includes Audiology, ENT, Speech, Genetics
- DK State Department of Health's Early Hearing Detection & Intervention Program (EHDI) will be notified of these results

TEST RESULTS:

Otoscopy:
Right: Clear canal
Left: Clear canal

Middle Ear Studies: Tympanometry tested with a 1000 Hz probe tone
Right: Consistent with normal middle ear function
Left: Consistent with normal middle ear function

Cochlear Studies: Distortion Product Otoacoustic Emissions (DPOAEs): 2000-8000 Hz
Right: Present at tested frequencies
Left: Absent at tested frequencies
Present DPOAEs suggest good cochlear outer hair cell function and indicate hearing likely ranges from within normal limits to no worse than mild hearing loss in at least the frequencies assessed.
Absent or reduced DPOAEs suggests poor cochlear function and/or the presence of middle ear pathology, likely indicating a reduction in hearing thresholds at tested frequencies.

Auditory Brainstem Response (ABR): A single-channel montage (Fz - Aipsi), stimulus rate of 27.70 clicks per second, Blackman window, multiple recordings and insert earphones was used.
Threshold testing: *ABR thresholds are generally closely correlated with behavioral hearing thresholds. It is important to corroborate findings with behavioral audiological testing as ABR is a measure of neural synchrony along the auditory pathway, not cortical auditory function.*
Morphology and repeatability: good
Sleep state: good

Right:

Tonebursts (TB):
1000 Hz: 20 dB eHL (with +10 dB correction)
4000 Hz: 20 dB eHL

Left:

Tonebursts (TB):
1000 Hz: 20 dB eHL (with +10 dB correction)
2000 Hz: 40 dB eHL
4000 Hz: 30 dB eHL
8000Hz: no response at 60 dB , did not test at higher intensities

Neurodiagnostic Click: Recorded in response to rarefaction and condensation click stimuli with click stimulation at 60 dB eHL

Right:
- Absolute and interpeak latencies: Within normal limits
- Wave V did not reverse with change in polarity, suggesting true neural response as opposed to auditory neuropathy spectrum disorder

Left:
- Absolute and interpeak latencies: Within normal limits
- Wave V did not reverse with change in polarity, suggesting true neural response as opposed to auditory neuropathy spectrum disorder

Thank you for allowing us to participate in care. If you have any questions or concerns, please feel free to contact me at 754-139-8675 or email me at lbrown@yodaearcenter.org.

Lucy Brown, AuD
Doctor of Audiology

Massachusetts Department of Public Health
Report of Audiological Evaluation

Ver 9

Newborn Hearing Screening Program
250 Washington Street, 5th Floor
Boston, MA 02108-4619
Telephone: 617-624-5527 Fax: 617-994-9822

Print Manual Form | Print Form | Save Work | Reset Form

Facility Name:

GENERAL INFORMATION:

Date of Evaluation: | Missed Appointment? | Out of State Birth | Home Birth
Child's First Name: | Last Name:
Child's Date of Birth: | Child's Gender: Male Female
Adult accompanying child is: Parent (Mother/Father) Other
Parent/Guardian's First Name: | Last Name:
Home/Cell Phone Number: (enter digits only) | Home/Cell Phone Number: (enter digits only)
Primary Care Provider Full Name
Was child previously evaluated? Yes No

PROCEDURES: Check all that apply

Electrophysiology	Otoacoustic Emissions	Immittance	Audiometry
Click ABR	DPOAE	Acoustic Reflex	Behavioral observation audiometry
Tone Burst ABR	TEOAE	Tympanometry	Visual reinforcement audiometry
Bone ABR			Play audiometry
ASSR			Conventional audiometry
Sedation			Sound field test
			Other Behavioral test (specify)

RESULTS:

Record results for both ears. If sound field test performed, mark better ear results. If hearing loss found, record type and degree of loss in each ear. If neuro component, choose subtype in box that opens. Press "Clear" button if you choose the wrong type by mistake.

	Better Ear	Left Ear	Right Ear
Type of Loss (Clear Hearing Results)	Normal hearing (-10 - 15 dB) Conductive loss only Type not determined Not tested Sensorineural Component	Normal hearing (-10 - 15 dB) Conductive loss only Type not determined Not tested Sensorineural Component	Normal hearing (-10 - 15 dB) Conductive loss only Type not determined Not tested Sensorineural Component
Degree of Loss (pure-tone average or best estimate thereof)			

Child's Name: , Evaluation:

KNOWN HEARING LOSS RISK INDICATORS: Check box if condition is known. Mark more than one condition if applicable.

Family History: Family history of permanent hearing loss in childhood

In utero/Congenital infection:
Cytomegalovirus | Herpes | Toxoplasmosis
Rubella | Syphilis | Zika

Neonatal Indicators:
Atresia and microtia | CHARGE association | Cleft lip | Cleft palate
Ear pits with preauricular tags | ECMO | Hyperbilirubinemia (>20 mg/dL) | Low birth weight (<1500 g)
Mechanical ventilation (>10 days) | Perinatal asphyxia | Prematurity (<32 weeks)
Pulmonary hypertension | Trisomy 21 (Down syndrome) | Other craniofacial anomaly

Other Conditions:
Bacterial meningitis | Chemotherapy | NICU Stay >5 days | Head Trauma
Ototoxic medication | Parental concern | Speech/language delay
Syndromes associated with hearing loss
Other Risks

List the initial examination dates for the following: (If exact date is unknown, use the 1st day of the month.)
Otolaryngology Date: | Cochlear Implant Surgery Date:
Ophthalmology Date: | Hearing Aids Fit Date:
Genetics Date: | Next Audiological Exam Date:

RESOURCES: Check box if information on the following programs was reviewed with parent/guardian(s):
Early Intervention? | MA Commission for the Deaf & Hard of Hearing? | UNHSP Parent Information Kit?

DIAGNOSIS/EI REFERRAL: Check box if the answer to the question is yes.
Is it your opinion that this child has permanent hearing loss? | Did you directly refer this child to Early Intervention?
Notes:

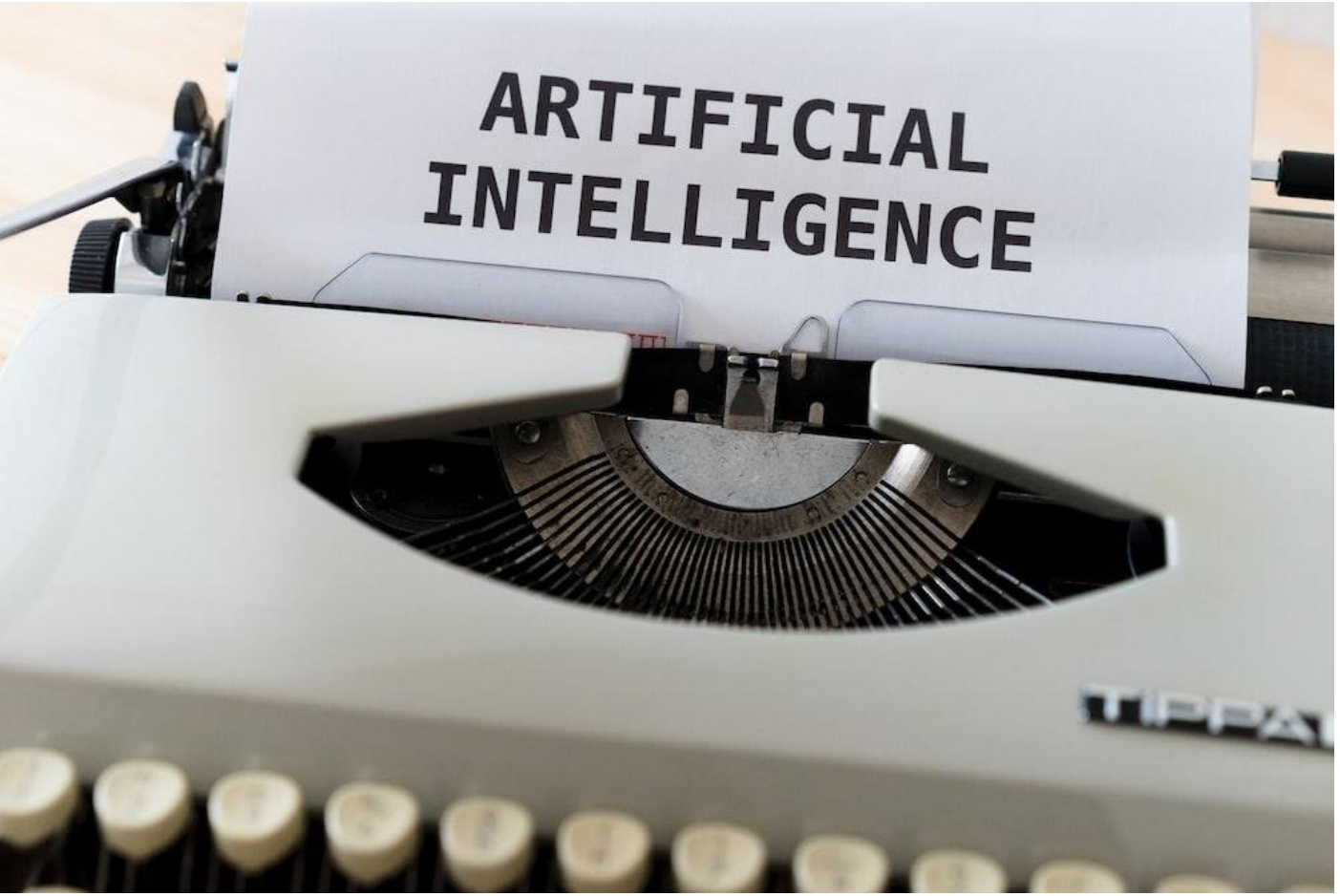
AUDIOLOGIST PERFORMING EVALUATION: (Select Audiologist Name from drop down list.)
Audiologist's Name: | Date Completed by Audiologist:

This form must be submitted through SecureMail within 3 days of examination. Login through:
https://ppsecuremail.state.ma.us/encrypt.
Email completed form to: newborn.hearing@eohhs-sfed.state.ma.us

Print Manual Form | Print Form | Save Work

Why a solution?

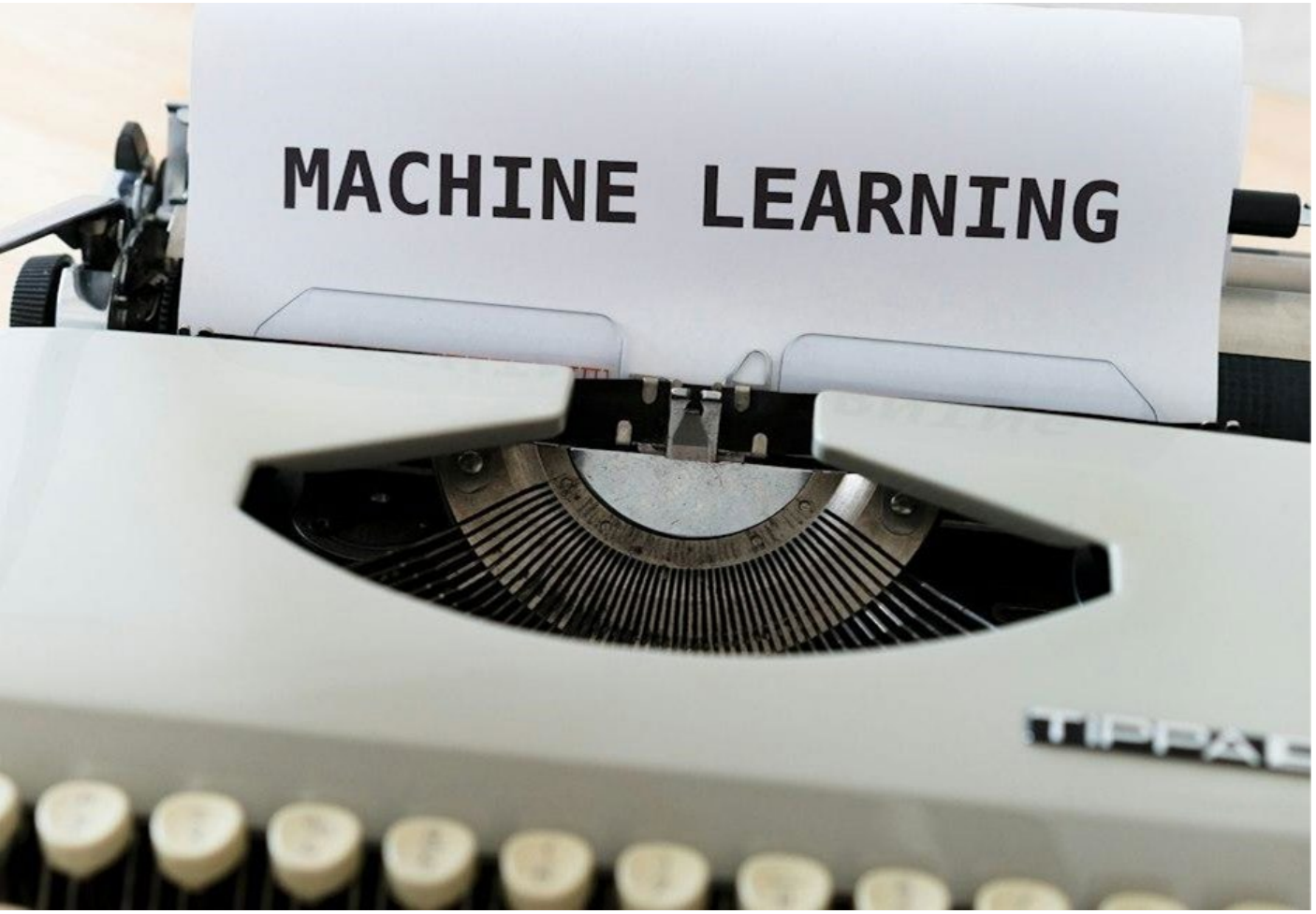
- Reduce duplicative data entry
- Reduce audiologist burden
- Reduce time spent on reporting
- Decrease loss to documentation
- Improve data quality and standardize categorization of hearing status
- Compliance and coordination
- Reduce disparities



"The term 'artificial intelligence' means a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments."

National Artificial Intelligence Act of 2020

https://www.state.gov/artificial-intelligence/



“Machine learning (ML) is using computers to identify patterns in datasets and make predictions on what the computer learns from those patterns.”

ML is a specific type of AI

https://www.energy.gov/science/doe-explainsmachine-learning

"A large language model (LLM) is a narrow artificial intelligence (AI) system that has been trained on a massive amount of text data to interpret natural language and generate human-like responses to text-based prompts or questions"

LLMs use logical rules to draw conclusions through reasoning engines

Anthropic Model : Claude 3.7 Sonnet https://docs.anthropic.com/en/docs/about-claude/models/all-models

https://pmc.ncbi.nlm.nih.gov/articles/PMC10485814/

Why use AI/ML for EHDI?

Challenge	AI/ML Solution
Duplicative and time-intensive reporting	Automated data collection and streamlined data entry
Incomplete and inconsistent data	Threshold levels translated and standardized reporting
Clinical notes contain a lot of information on the patient's diagnosis and experience	Translate notes into data elements needed for EHDI reporting through data mining

Proof of Concept project partners

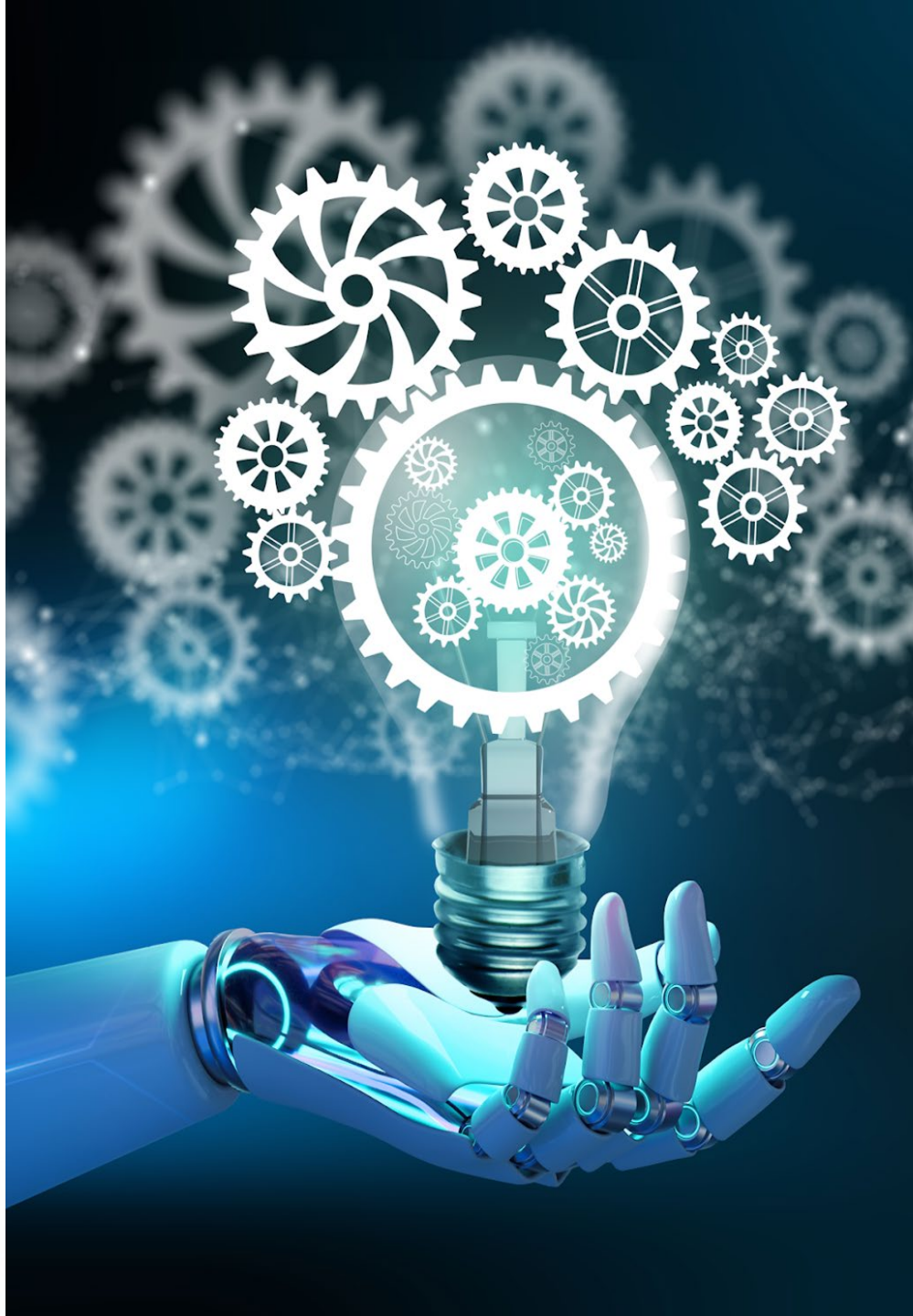
- The CDC EHDI Program
- Public Health Informatics Institute
- Amazon Web Services Cloud Innovation Center
  - Cal Poly Digital Transformation Hub
- Mass Eye and Ear
- Boston Children's Hospital Audiology Program
- Massachusetts Infant Hearing Program

Automated Audiology Extraction Project status

- Partners secured and engaged
- Data use agreements in place
- Proof of Concept in development by students at Cal Poly
- Will be available on a GitHub page for moving into production
- Collaboration with the Association of Public Health Laboratories to explore scalability and hosting for more jurisdictions

What is needed for AI/ML project success?

- Project management & planning
- Data Sharing Agreements
- Partner engagement



Tips for project management & planning

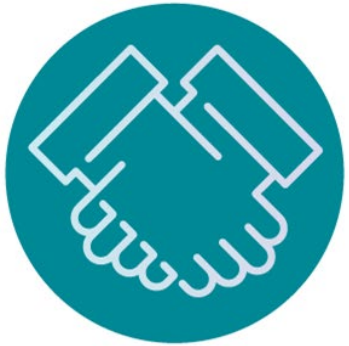
- Clarify roles and responsibilities clearly from the beginning
  - Draft a project RASCI chart

RASCI: sample						
#	Activity	Responsible	Accountable or approver	Supportive	Consulted	Informed
1	Review legal guidelines	Sally	Sally's supervisor	Legal team	PHII	Program Manager
2	Establish Data Use Agreements	Sally	Sally's supervisor	Tiffany	N/A	Program Manager
3	Test AI/ML application	Sally	Sally's supervisor	Fred	N/A	Program Manager

- Identify a project manager to coordinate communication and facilitate meetings
- Establish a regular cadence of meetings with partners
- Establish early the need for data use agreements and the processes needed
- Plan for partner conflicts and the competing priorities of IT resources

Tips for Data Sharing Agreements

- **Establish trust** which is critical to data-sharing which happens at the speed of trust
- **Establish a common language** to achieve common understanding and communicate
- **Identify who from the jurisdiction/clinic** needs to be involved to get the right signatures/approvals
  - Involve IT and legal early on in the process
- **Identify and discuss any concerns** the data-sharing partner has regarding this type of work
- **Transparency and consistency** must be maintained throughout the project to have a successful data-sharing project.



Health information sharing happens at the speed of trust.

Tips for partner engagement

- **Engage programmatic staff, leadership staff, and IT staff**—particularly in jurisdictions—**early**
  - IT staff are often the gatekeepers to services and data and they need to be on board early to garner support for the project for the work to be successful.
- **Document partner workflows** to ensure that you are meeting the programmatic needs
- **Fully understand all steps** that will be taken during the project's development and implementation
- **Consider the technical partner company headquarters**
  - Some jurisdictions require US-based partners

Resources for AI/ML projects in your jurisdiction

- ASTHO's AI-mapped state legislation: https://www.astho.org/advocacy/state-health-policy/public-health-legal-mapping-center/infrastructure/ai/
- Questionnaire to complete before talking with your state attorney: https://phii.org/wp-content/uploads/2021/10/CAMH_Fillable-PDF_FINAL_10-26-21.pdf
- Project governance: roles and responsibilities worksheet: https://phii.org/download/project-governance-roles-and-responsibilities-worksheet/

Resources for AI/ML projects in your jurisdiction

- AWS Blogs:
  - https://aws.amazon.com/ai/responsible-ai/
  - https://aws.amazon.com/blogs/machine-learning/a-progress-update-on-our-commitment-to-safe-responsible-generative-ai/

- Network for Public Health Law resources: https://www.networkforphl.org/
- Network for Public Health Law webinar: AI and Public Health: Opportunities and Challenges
  - https://www.networkforphl.org/resources/ai-and-public-health-opportunities-and-challenges/

Resources for AI/ML projects in your jurisdiction

- Developing Artificial Intelligence (AI) Policies for Public Health Organizations: A Template and Guidance https://www.khi.org/articles/developing-artificial-intelligence-ai-policies-for-public-health-organizations-a-template-and-guidance/

Other considerations in case you can't use AI/ML

- DAR IG Standard for Trial Use: www.hl7.org/documentcenter/public/ballots/2021JAN/downloads/V2_IG_DIAGAUDIORPT_R1_D1_2021JAN.pdf
  - Session on March 11 at 3 pm, Electronic Diagnostic Audiology Reporting using HL7 Standards, Room 317/318

For more information on HL7

- HI7.org
- Public Health Work Group https://confluence.hl7.org/display/PHWG/Public+Health+Work+Group

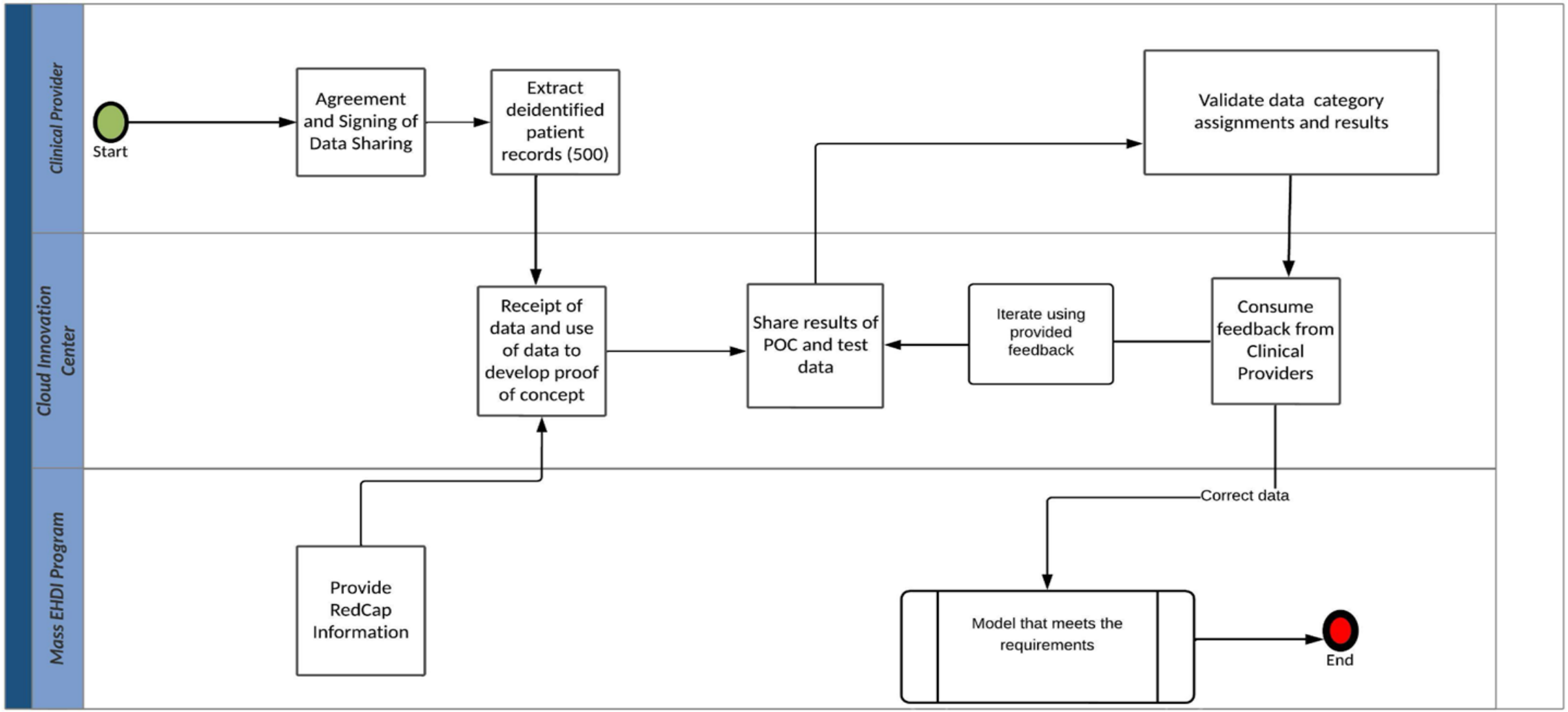
Future project updates

- Public Health Informatics Institute website PHII.org
- Cal Poly News: https://dxhub.calpoly.edu/news/

Questions

- Email: Lura Daussat ldaussat@taskforce.org
- Email: Tonny Bogere tbogere@taskforce.org
- Email: CDC EHDI ehdico-op@cdc.gov

The Automated Audiology Reporting Concept Project



General Process Notes:
1. Data sharing agreements are only needed between clinical providers and the CIC.
2. PHII will develop Scopes of Work with the Clinical Providers to ensure payment for time spent on this project.

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