Childhood Cancer Data Initiative Webinar Series

The National Childhood Cancer Registry (NCCR): Leveraging Data Standards for Improving Interoperability

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NIH NATIONAL CANCER INSTITUTE

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Today's Speakers

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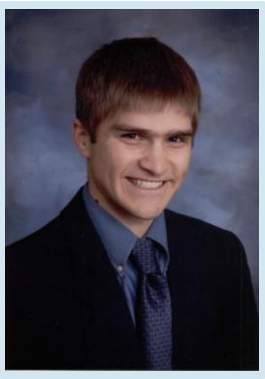


David Noyd, M.D., M.P.H.
Pediatric Hematology/ Oncology Physician and Clinical Informaticist at Seattle Children's Hospital

Assistant Professor of Pediatrics at the University of Washington

Disclosures

- Wayne Liang, Nikki Wood, and David Noyd are Westat consultants to the NCI Surveillance Research Program and Clinical Consultants for Oncology Research and Evaluation Program.
- Wayne Liang is also a consultant and advisor for ChemoMap and Genoplex.ai.

Agenda

1. NCCR Data Platform and Pediatric Data Standards
2. NCCR Data Harmonization Process
3. Implementing Treatment Standards: HemOnc.org
4. Minimal Common Oncology Data Elements (mCODE)

NCCR Data Platform and Pediatric Data Standards

Wayne H. Liang, M.D., M.S.

Central Cancer Registries

NCI SEER (Surveillance, Epidemiology, and End Results):

- 50% of U.S. population
- More detailed data

CDC NPCR (National Program of Cancer Registries):

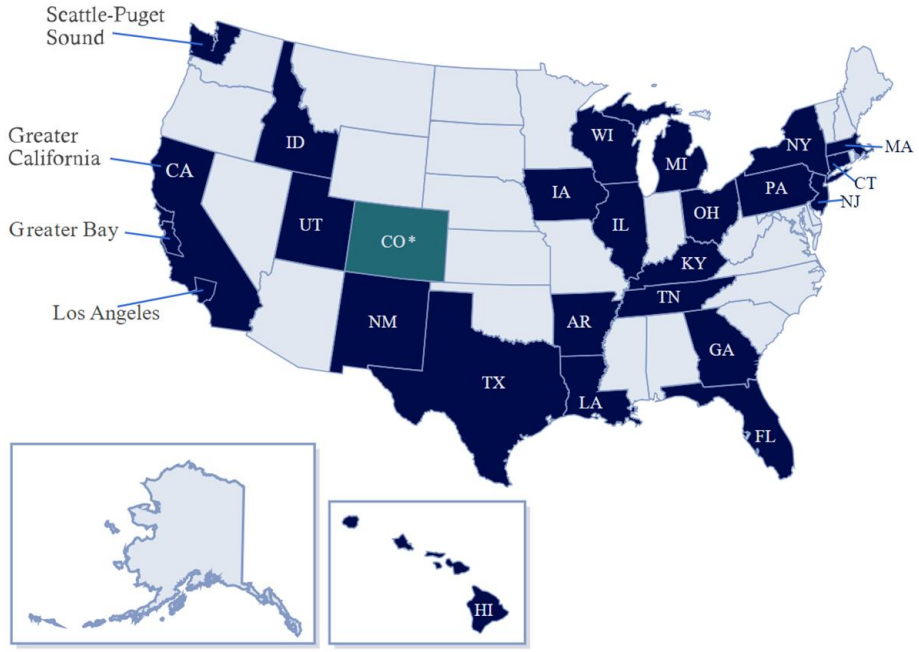
- 96% of U.S. population
- Less detailed data

Characteristics

- **State-based**
- **Federally mandated** reporting
- **Manually abstracted** from treatment centers
- Generates **national cancer statistics**
- **Lacks comprehensive data** required to understand the full patient journey

National Childhood Cancer Registry (NCCR)

- Component of **CCDI**
- A **connected** data infrastructure to enable **sharing** of childhood cancer data from **multiple and heterogeneous** data sources
- Enriches **SEER and NPCR** data with other data



* Data from Colorado is not yet included in the current NCCR data release.

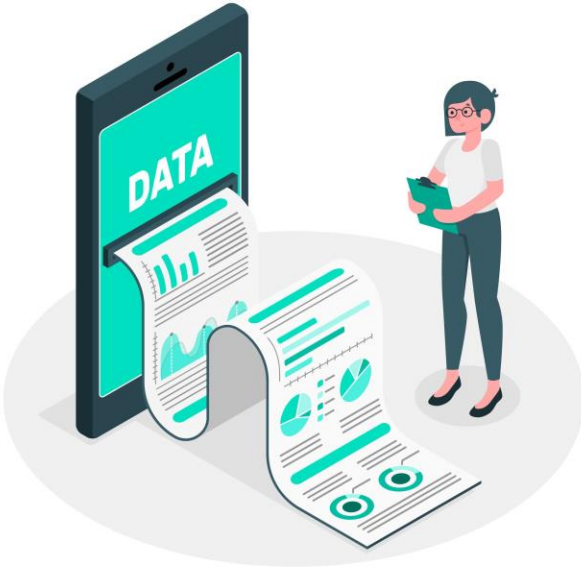
NCCR Data Sources and Domains

Data Sources

- Central Registries
- **NCI-Designated Cancer Centers**
- Children's Oncology Group (COG)
- Pediatric Proton/Photon Consortium Registry (PPCR)
- Virtual Pooled Registry (VPR)
- Administrative data sources
- Clinical trials, survivorship studies, etc.

Data Domains

- Longitudinal treatment, comorbid conditions, procedures, outcomes, etc.
- Social determinants of health
- Radiation oncology treatment
- Clinical genomic reports



Source: Canva

NCCR Data Products

NCCR*Explorer

- Open access
- 25 NCCR registries:
  - 70% of U.S. population
  - 1,700,440 reported cancer cases
- Sources: SEER NCCR; NAACCR CiNA submissions

nccrexplorer.ccdi.cancer.gov/application.html

NCCR Data in SEER*Stat

- Registered access
- User queries
- 15 NCCR registries:
  - 49% of U.S. population
  - 973,935 reported cancer cases
- Sources: NAACCR CiNA submissions; transition to NCCR submissions

seer.cancer.gov/seerstat/

datacatalog.ccdi.cancer.gov/dataset/CCDI-NCCR%20SEER*Stat

Coming soon!

NCCR Data Platform

- Registered and controlled access
- User queries
- Cloud-based or downloaded custom data sets (approved, individual-level)
- 18 SEER core and 4 SEER RSR registries:
  - 57% of U.S. population
  - 1,543,269 reported cancer cases
- Sources: Multiple linked and harmonized data sources (central registries, NCCR submissions, other)

*Dx @ ages 0-19 for some registries

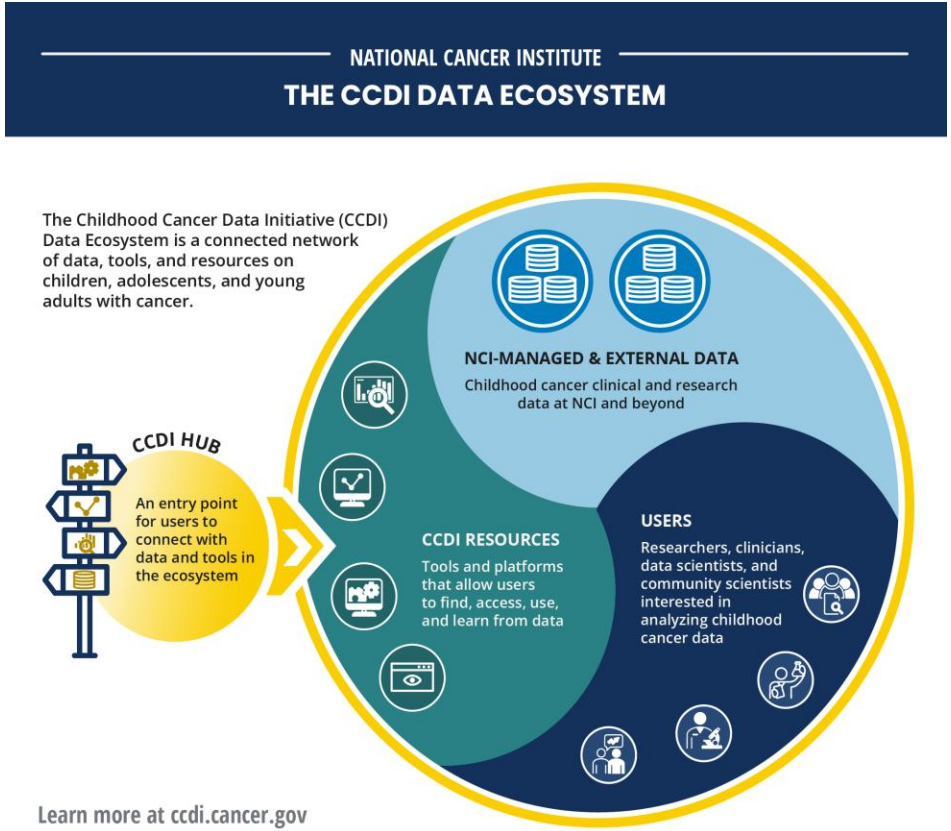
CCDI Data Harmonization Objectives

- Establish **consistent and interoperable standards** for collecting, storing, and sharing pediatric cancer data
- Facilitate **data integration** across studies for streamlined analysis
- Develop **core pediatric elements** for clinical and research purposes

Source: Shutterstock

Data Standards: Cross-Domain Collaboration

- **Data standards** are critical for **interoperability** across the CCDI Data Ecosystem
- **CCDI data standards** are being developed in collaboration with the:
  - NCI Semantics Infrastructure Team
  - Pediatric Cancer Data Commons (University of Chicago)
  - CCDI Molecular Characterization Initiative Disease Committee
  - HemOnc.org
  - mCODE



NCI's Semantics Infrastructure: Promote Interoperability

NCI Thesaurus (NCIt):
- Controlled vocabulary of biomedical concepts

Cancer Data Standards Registry and Repository (caDSR):
- Structured repository for clinical and research metadata

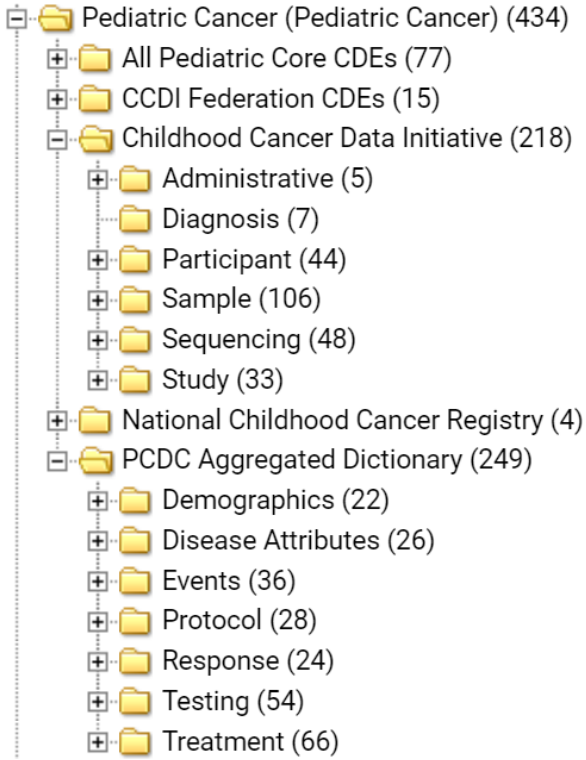
Common Data Elements (CDEs):
- Standardized metadata elements for clinical and research use
- Incorporates terms from NCIt
- Managed within caDSR

Source: Shutterstock

Pediatric Cancer CDEs

- 434 CDEs (as of July 2024)
- Multiple clinical and research domains:
  - Administrative, Demographics, Diagnosis, Treatment, Specimen, Molecular, and Imaging, etc.
- Linked to reference data standards or cross-walked to other CDEs

Reference Data Standards
HL7 FHIR mCODE, HemOnc.org, OMOP, PRISMM, OncoTree, UBERON, OBO, GA4GH, HGVS, PCORnet, HPO, SNOMED CT, LOINC, ASTRO, etc.



cadsr.cancer.gov/onedata/Home.jsp

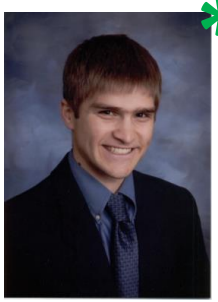
NCCR Data Harmonization Process

C. Austin Fitts, Pharm.D.

NCCR Cancer Center Data Harmonization Clinical Team

Austin Fitts, Pharm.D.
National Cancer Institute

Elaine Fan, M.D.
University of Kansas, Wichita



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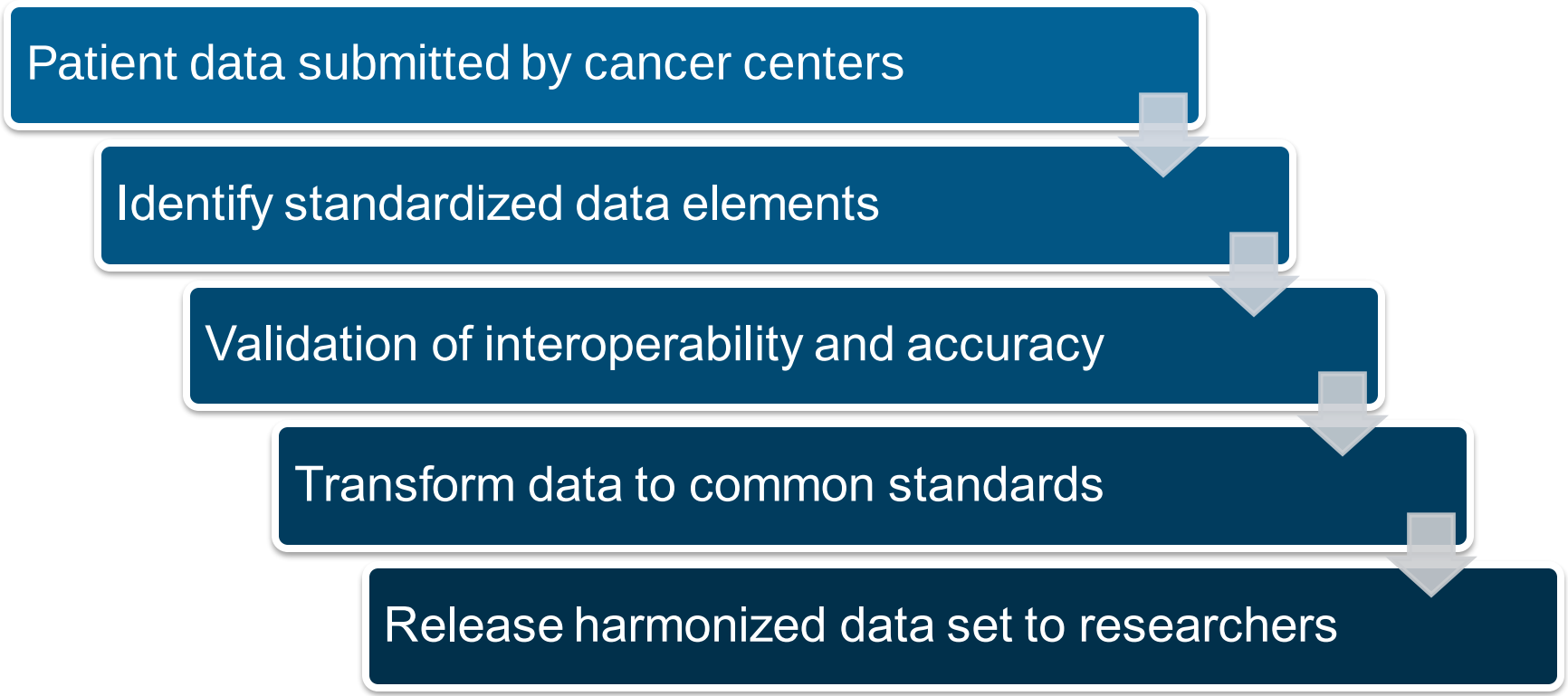
HemOnc.org Editorial Board Pediatric Team

NCCR Cancer Center Data Harmonization (2021)

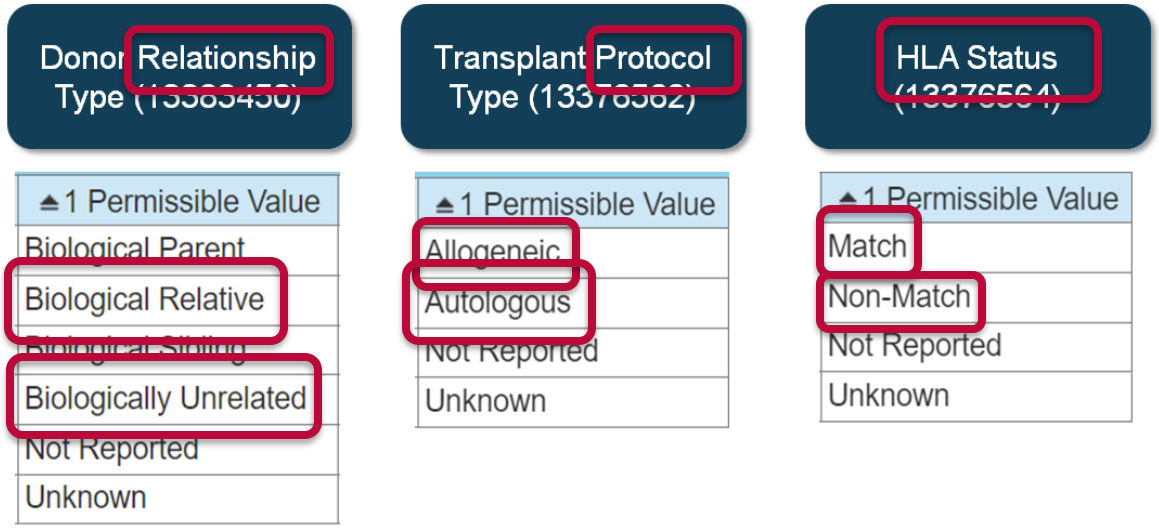
* **CC-DIRECT** (Childhood Cancer–Data Integration for Research, Education, Care, and Clinical Trials)
Standards Task Team

Methods for Harmonization of Complex Data Elements



Harmonization Example: Transplant Type

- Cancer Center Permissible Values
  - Matched Unrelated
  - Autologous
  - Matched Related
  - Unknown
  - Syngeneic
  - Haploidentical Related
  - Other



Harmonization Example: Transplant Type

Cancer Center Permissible Values	Donor Relationship Type (13383450)	Transplant Protocol Type (13376562)	HLA Status (13376564)
Autologous	Not Applicable	Autologous (C16039)	Not Applicable
Matched Unrelated	Biologically Unrelated (C130053)	Allogenic (C46089)	Match (C129972)
Haploidentical related	Biological Relative (C71384)	Allogenic (C46089)	Non-Match (C126298)
Syngeneic	Biological Sibling (C100809)	Allogenic (C46089)	Match (C129972)

Cancer Center Supplements: Data Harmonization

- 12 Cancer Centers
  - Submitted 6,500 columns
  - Representing over 25,000 patients
  - Across 23 million rows of patient data
- General Stats
  - Over **3.5 billion** non-null **data points** to harmonize
  - Average of **77,000** data points submitted **per patient**
  - Average **data completeness** was **96%** (% of non-null data)

Breakdown of Harmonized Data Elements (n = 345)

15% (n=50)
Outcomes and Complications

15% (n=55)
Patient Demographics

7% (n=22)
Genomics

24% (n=82)
Diagnosis

34% (n=116)
Treatments

6% (n=20)
Procedures

Source: Canva

Examples of Cancer Center Data Elements Augmenting

Patient Demographics	Diagnosis	Treatments	Outcomes
Insurance	Performance Status	Chemotherapy Received	Lab Results
Education Level	Morphology	Radiation Received	Complications and Adverse Events
Past Medical History	Tumor Genomics	Stem Cell Transplants	Hospital Admissions

Cloud-Native Data Sharing through the NCCR Data Platform

Authentication and Authorization	• Federated identities for authentication • Approve users using SEER Data Access Request process • Continually validate appropriate data use and manage authorization
Data Browser	• Learn about data sources linked to registry data using PII or PPRL
Cohort Discovery	• Search for a defined cohort of patients and view aggregate statistics and counts
Governance	• Request access to individual-level data and support reviews of requests • Create custom data sets for a user based on the data access request
Data Release and Analysis	• Release custom data sets to researchers for analysis with statistical software programs like R Studio, Jupyter Notebooks, SAS
CCDI Data Ecosystem	• Enable data sharing with other CCDI data resources (e.g., CRDC) at NCI and other institutions

Implementing Treatment Standards: HemOnc.org

Nikki Wood, D.O.

Comparing Cancer Treatment Using Real World Data

Challenges

Central registry data lacks detailed treatment data

Treatment as Prescribed vs Treatment Received—Dose modifications, missed doses, missing data

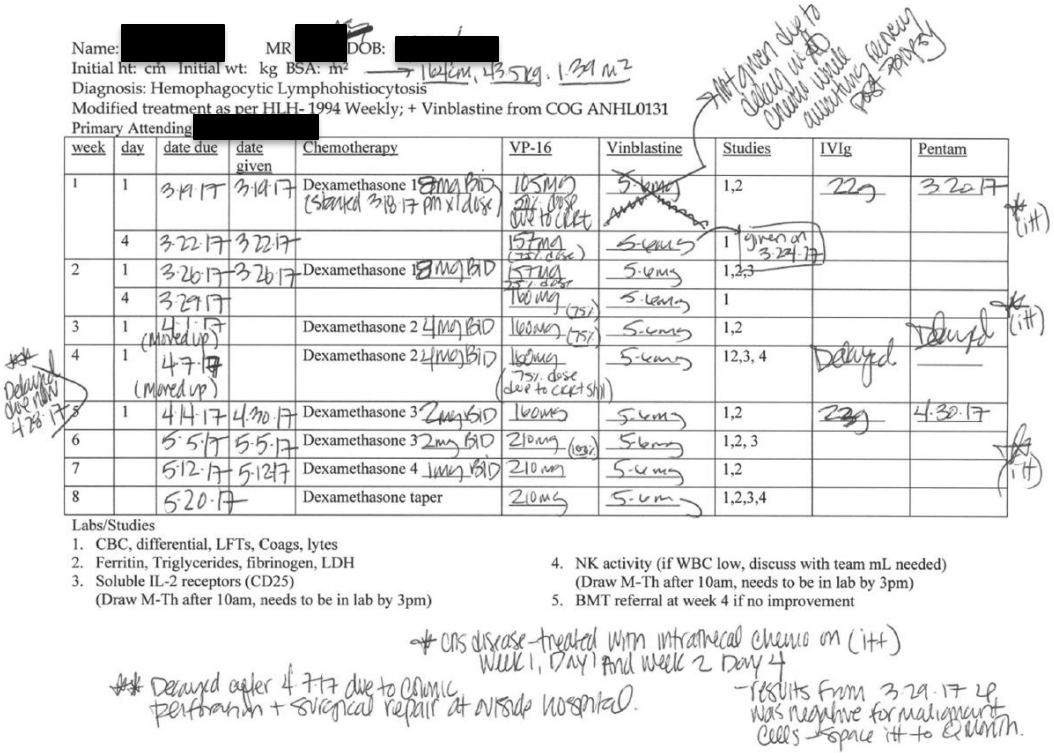
Needs

Medication administration record and prescription filling data

Match drugs/treatments to cancer regimens

A standardized vocabulary of regimens

Challenge of Paper Chemotherapy Roadmaps



Name: [redacted] MR [redacted] DOB: [redacted]
Initial ht: cm Initial wt: kg BSA: m²
Diagnosis: Hemophagocytic Lymphohistiocytosis
Modified treatment as per HLH-1994 Weekly; + Vinblastine from COG ANHL0131
Primary Attending [redacted]

week	day	date due	date given	Chemotherapy	VP-16	Vinblastine	Studies	IVIg	Pentam
1	1	3.14.17	3.14.17	Dexamethasone 1 8mg/m²/d BID (started 3.18.17 pm x1 dose)	105mg/m² 20% dose due to CLL	5.4mg	1,2	22g	3.20.17
	4	3.22.17	3.22.17		157mg (75% dose)	5.4mg	1		
2	1	3.26.17	3.26.17	Dexamethasone 1 8mg/m²/d BID	157mg 75% dose	5.4mg	1,2,3		
	4	3.29.17			160mg (75%)	5.4mg	1		
3	1	4.1.17 (Moved up)		Dexamethasone 2 4mg/m²/d BID	160mg (75%)	5.4mg	1,2		
4	1	4.7.17 (Moved up)		Dexamethasone 2 4mg/m²/d BID	160mg 75% dose due to CLL	5.4mg	12,3, 4	Delayed	
5	1	4.14.17	4.30.17	Dexamethasone 3 2mg/m²/d BID	160mg	5.4mg	1,2		4.30.17
6		5.5.17	5.5.17	Dexamethasone 3 2mg/m²/d BID	210mg (100%)	5.4mg	1,2, 3		
7		5.12.17	5.12.17	Dexamethasone 4 1mg/m²/d BID	210mg	5.4mg	1,2		
8		5.20.17		Dexamethasone taper	210mg	5.4mg	1,2,3,4		

Labs/Studies
1. CBC, differential, LFTs, Coags, lytes
2. Ferritin, Triglycerides, fibrinogen, LDH
3. Soluble IL-2 receptors (CD25) (Draw M-Th after 10am, needs to be in lab by 3pm)
4. NK activity (if WBC low, discuss with team mL needed) (Draw M-Th after 10am, needs to be in lab by 3pm)
5. BMT referral at week 4 if no improvement

- Chemotherapy regimens are complex
- Paper roadmaps are the mainstay for documentation
- Efforts to create machine-interpretable electronic roadmaps will facilitate standardized, discrete, and transferable chemotherapy regimen metadata

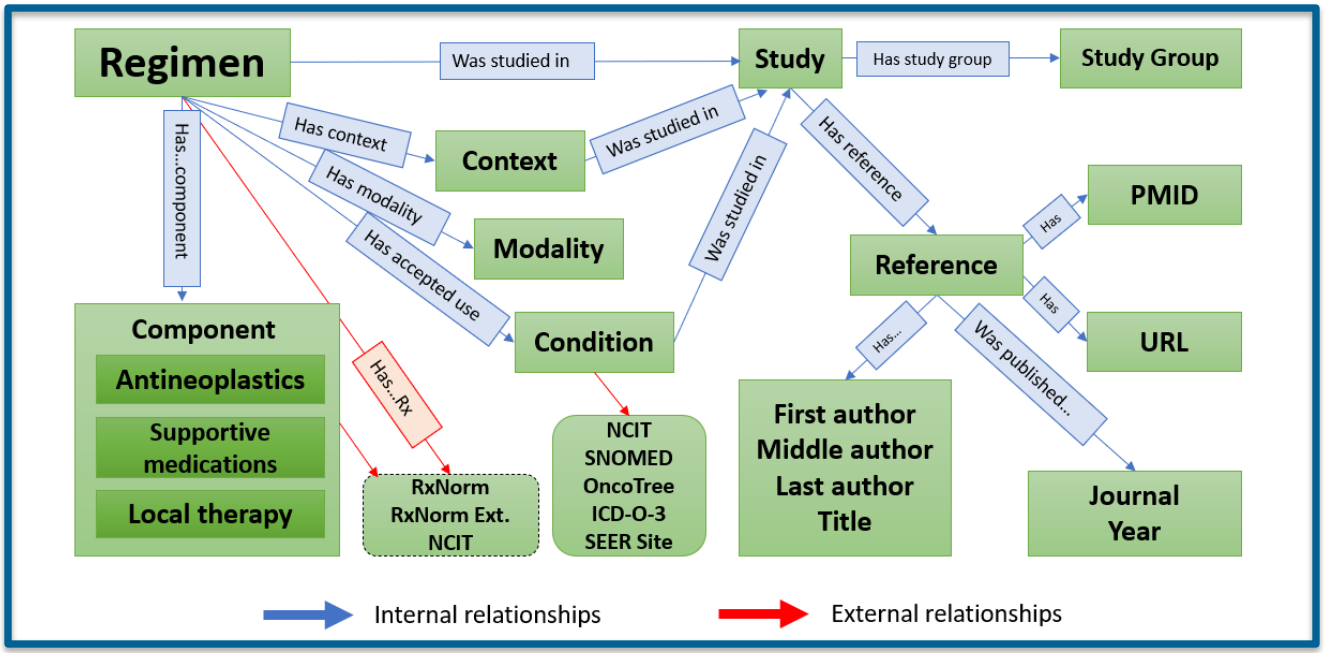
Wyatt KD, Noyd DH, Wood NM, et al. Data standards in pediatric oncology: Past, present, and future. *Pediatric Blood & Cancer*. 2023 Feb. doi: 10.1002/pbc.30128.

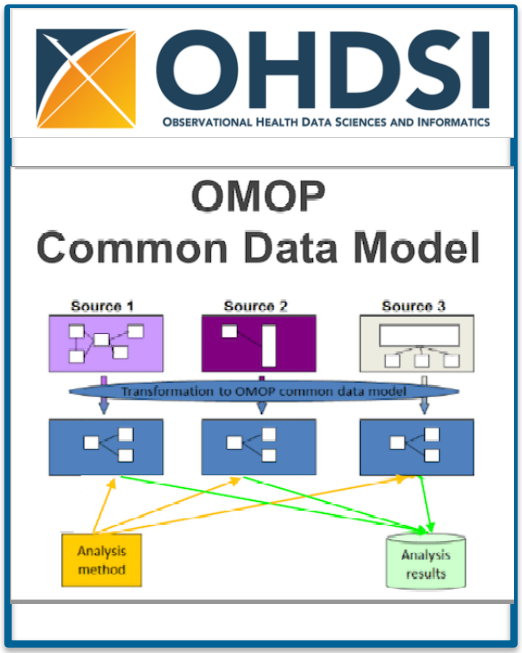
HemOnc.org Vocabulary of Cancer Regimens

- Largest freely available, computable knowledge resource of cancer regimens
- **Machine readable standard vocabulary** for chemotherapy regimen representation in the OMOP common data model
- Derived from HemOnc.org website
- **Free for non-commercial use**
- Available within **OHDSI ATHENA** vocabularies repository: athena.odhsi.org
- Available on **Harvard Dataverse** for download: dataverse.harvard.edu/dataverse/HemOnc

> "An ontology is a FORMAL, EXPLICIT, specification of a SHARED conceptualization."
>
> – Rudi Studer (1998)

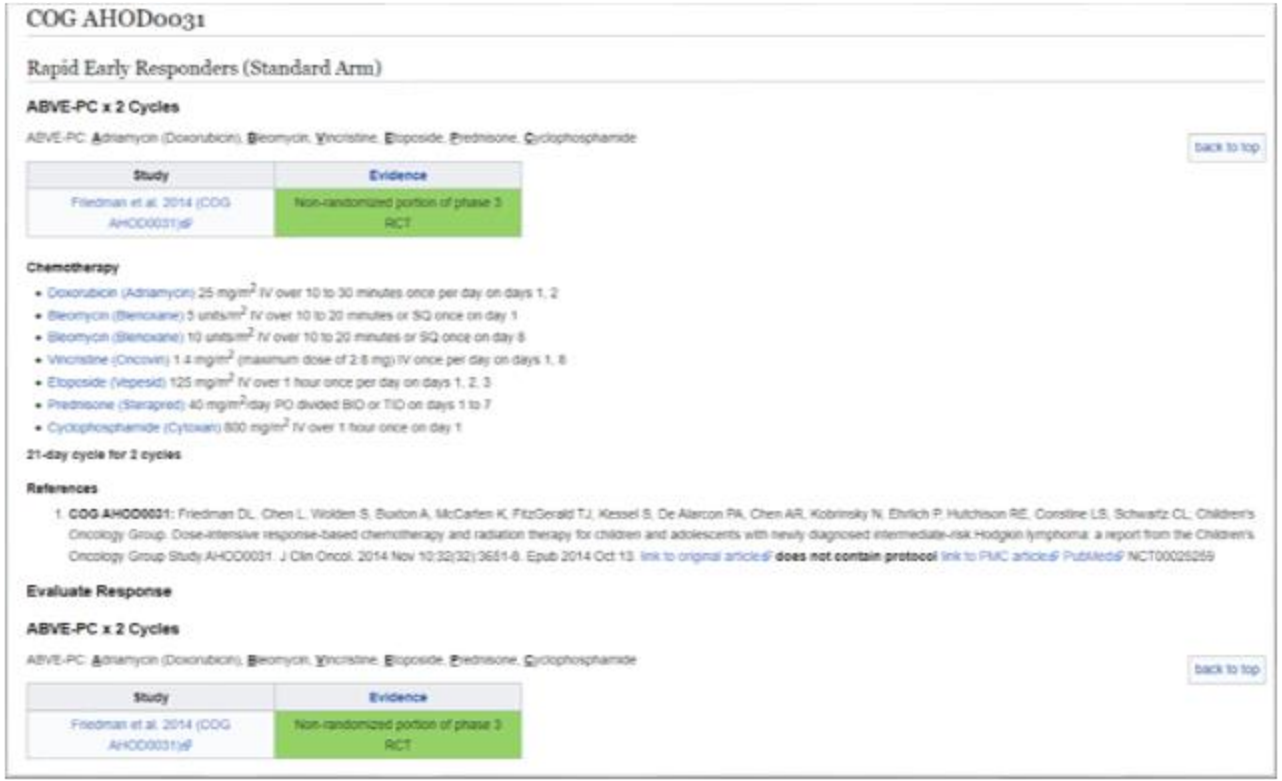
The HemOnc Regimen Model





Warner JL, Dymshyts D, Reich CG, et al. HemOnc: A new standard vocabulary for chemotherapy regimen representation in the OMOP common data model. *Journal of Biomedical Informatics*. 2019 Aug. doi: 10.1016/j.jbi.2019.103239.

HemOnc.org Example Regimen: COG AHOD0031



COG AHOD0031

Rapid Early Responders (Standard Arm)

ABVE-PC x 2 Cycles

ABVE-PC: Adriamycin (Doxorubicin), Bleomycin, Vincristine, Etoposide, Prednisone, Cyclophosphamide

back to top

Study	Evidence
Friedman et al. 2014 (COG AHOD0031)	Non-randomized portion of phase 3 RCT

Chemotherapy

- Doxorubicin (Adriamycin) 25 mg/m^2 IV over 10 to 30 minutes once per day on days 1, 2
- Bleomycin (Blenoxane) 5 units/m^2 IV over 10 to 20 minutes or SQ once on day 1
- Bleomycin (Blenoxane) 10 units/m^2 IV over 10 to 20 minutes or SQ once on day 8
- Vincristine (Oncovin) 1.4 mg/m^2 (maximum dose of 2.8 mg) IV once per day on days 1, 8
- Etoposide (Vepesid) 125 mg/m^2 IV over 1 hour once per day on days 1, 2, 3
- Prednisone (Sterapred) 40 mg/m^2/day PO divided BID or TID on days 1 to 7
- Cyclophosphamide (Cytoxan) 600 mg/m^2 IV over 1 hour once on day 1

21-day cycle for 2 cycles

References

1. **COG AHOD0031:** Friedman DL, Chen L, Wolden S, Buxton A, McCarten K, FitzGerald TJ, Kessel S, De Alarcon PA, Chen AR, Kobrinsky N, Ehrlich P, Hutchison RE, Considine LS, Schwartz CL; Children's Oncology Group. Dose-intensive response-based chemotherapy and radiation therapy for children and adolescents with newly diagnosed intermediate-risk Hodgkin lymphoma: a report from the Children's Oncology Group Study AHOD0031. J Clin Oncol. 2014 Nov 10;32(32):3651-8. Epub 2014 Oct 13. link to original article **does not contain protocol** link to PMC article PubMed NCT00025259

Evaluate Response

ABVE-PC x 2 Cycles

ABVE-PC: Adriamycin (Doxorubicin), Bleomycin, Vincristine, Etoposide, Prednisone, Cyclophosphamide

back to top

Study	Evidence
Friedman et al. 2014 (COG AHOD0031)	Non-randomized portion of phase 3 RCT

HemOnc.Org. Classical Hodgkin lymphoma, pediatric. Edited June 27, 2024. https://hemonc.org/wiki/Classical_Hodgkin_lymphoma,_pediatric#COG_AHOD0031.

Uses of HemOnc.org Regimen Vocabulary

Disease → Common Cancer Regimens

Identify regimens that a patient with a given cancer may have received

Cancer Regimen → Components

Resolve missing or conflicting data when the regimen is known

Regimen Components → Likely Regimens

Identify possible regimens that a patient received based on chemotherapy components

Real World Data → Real World Evidence

Enables *comparative analysis* of cancer treatments real patients received using registry data

Mapping of NCCR treatment data to HemOnc.org regimen vocabulary may augment the use of NCCR for comparative analysis of cancer treatments.

Minimal Common Oncology Data Elements (mCODE)

David H. Noyd, M.D., M.P.H.

Minimum Common Oncology Data Elements (mCODE)

A FHIR-based core set of common data elements for cancer that is standardized, computable, clinically applicable and available in every electronic health record for patients with a cancer diagnosis

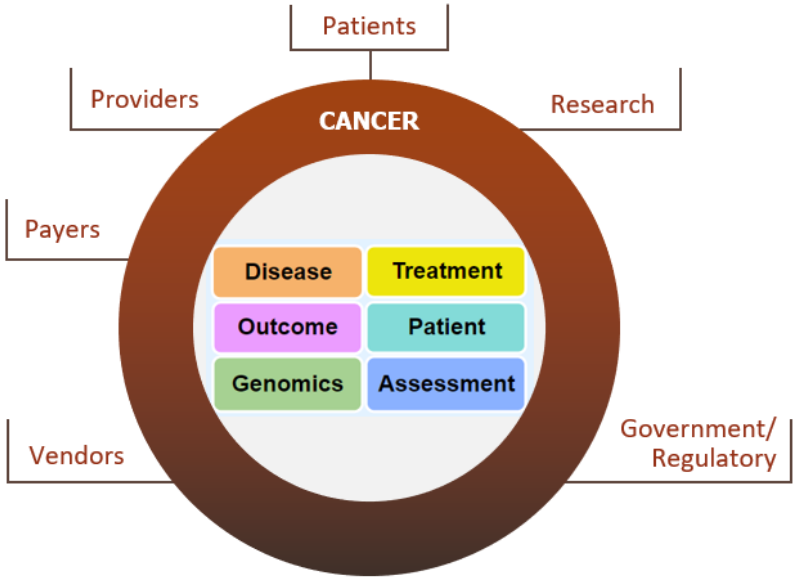
A **standard health record** for oncology

The **minimal set of data elements** applicable to all cancers, and collected for:

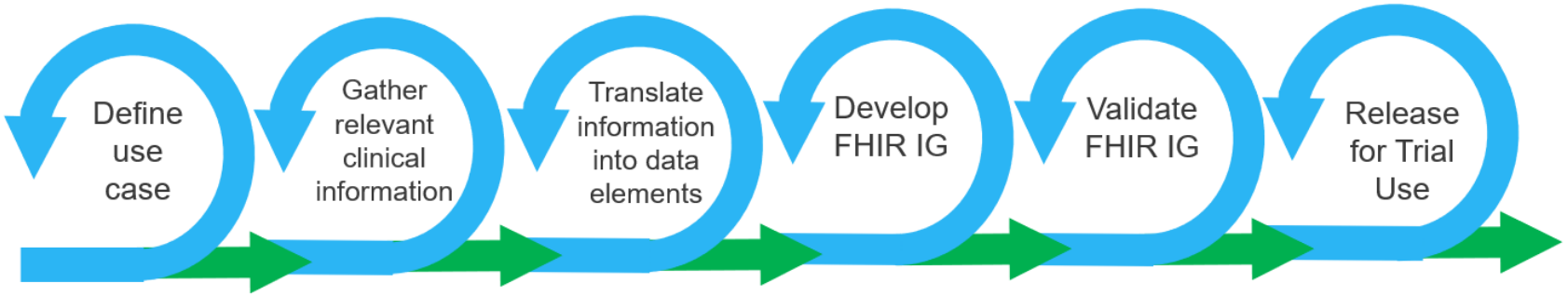
Standardized information exchange

Use-case driven and targeted use

Oncology data element domains: **patient, disease, treatment, outcomes, genomics, lab/vital**



FHIR Implementation Guide Process (Initial Methodology)



- Purpose
- Drivers
- Use case scenario
- Persona

- Clinical Information inventory
- Concept Model (Mind Map)
- Logical Model

- Data Dictionary to Clinical Information Cross-Walk ("*Rosetta stone*")

Include:
- Documentation
- Data Dictionary

- Examples
- FHIR reference implementation

- Early Pilots
- Connectathons

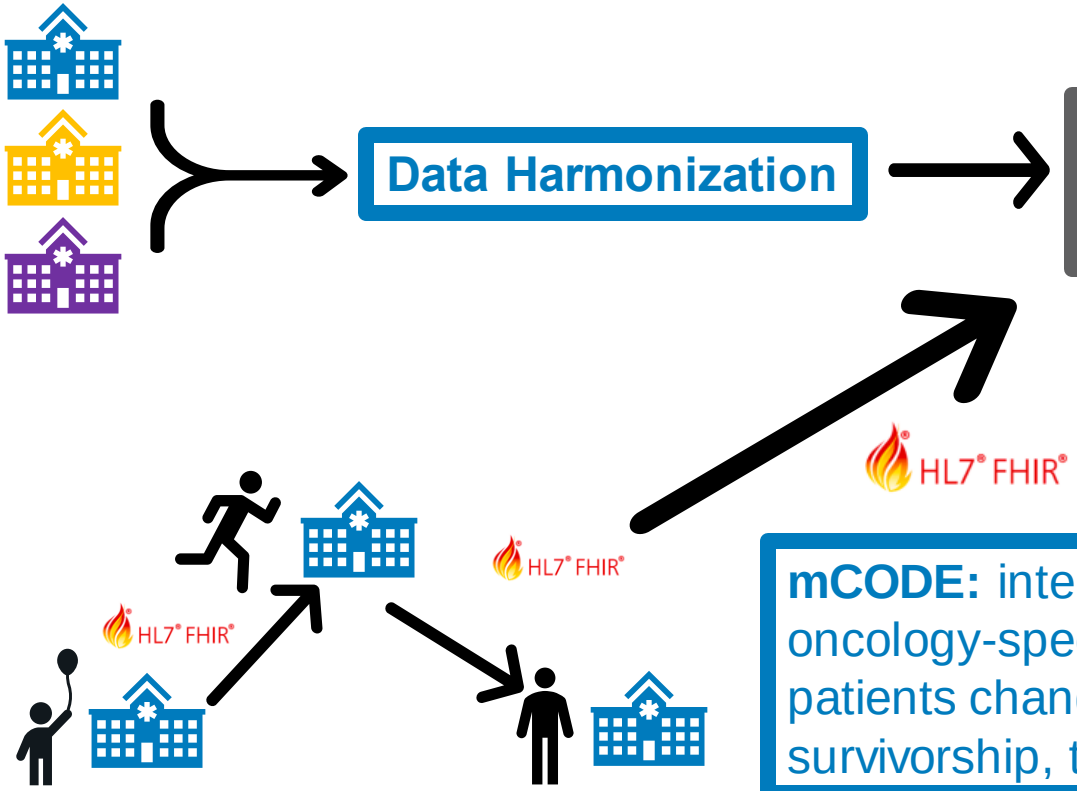
Childhood Cancer-Data Integration for Research, Education, Care, and Clinical Trials (CC-DIRECT)

- Expand **mCODE** to include data elements specific to childhood cancer
  - Identify data required for pediatric cancer
  - Compare with existing FHIR resources
  - Prioritize data
  - Determine data flow requirements
  - Model and align with other work
  - Propose mCODE update

CC-DIRECT: Leveraging mCODE to create a standardized cancer health record

- Enable automatic extraction of discrete data elements from the electronic health record to align with data standards for NCCR
  - Generate real-world data evidence
  - Reduce time-intensive harmonization of data
  - Promote interoperability of data to support clinical and patient navigation from diagnosis through survivorship

Data Standards



mCODE: interoperability to improve portability of oncology-specific data across institutions as patients change health systems for treatment, survivorship, transition to adult care

Childhood Cancer Survivorship as a Use Case

CCSS
CHILDHOOD CANCER SURVIVOR STUDY

Risk Prediction Calculators

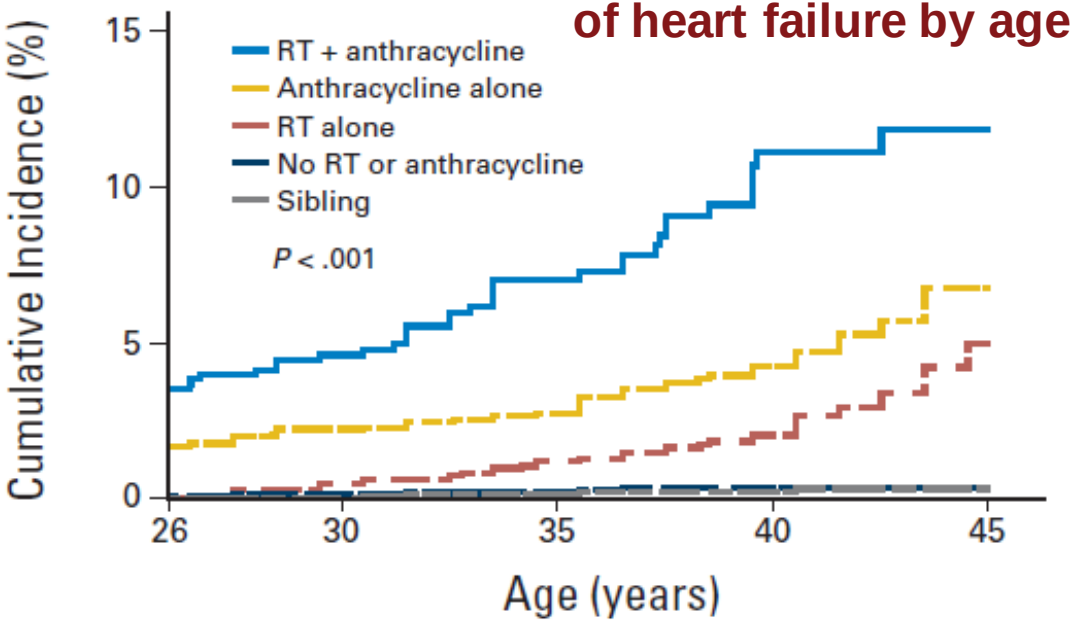
Acute Ovarian Failure Risk Prediction Calculator Learn More	Breast Cancer Probability Calculator Learn More	Cardiovascular Risk Calculator Learn More
Kidney Failure Calculator Learn More	Primary Ovarian Insufficiency Risk Calculator Learn More	

Passport for Care®
with the CHILDREN'S ONCOLOGY GROUP

Maps treatment exposures to LTFU Guidelines

Late Cardiovascular Disease Risk Stratification

11.7% cumulative incidence of heart failure by age 40



(Chow *et al* 2015; Armstrong *et al* 2020)

Data Elements Included in NCCR, CC-DIRECT

Data Elements
Anthracycline dose and field-specific radiation doses known, age at diagnosis, gender

Take Home Points

- The **NCCR** enhances **central cancer registry data** with linked and harmonized data from **hospitals, NCI-Designated Cancer Centers, administrative data sources** and **multiple other sources**
- **Data standards** are essential for interoperability across the CCDI Data Ecosystem
- The **NCCR Data Platform** is a new data resource for cancer research
- Future direction includes integrating with **mCODE** and **HemOnc.org**

Q&A

Join Us at Our Next Event

CCDI Federated Data: Enhancing Data Discoverability

Tuesday, August 13, 2024, from 1:00–2:00 p.m. ET

A new advancement for querying genomic, clinical, imaging, and biospecimen data is through a standard application programming interface (API). We invite the broader community to hear from representative members of the demonstration project and learn about advancing research through CCDI data federation.

Learn more and register at **events.cancer.gov/ccdi/webinar**

How You Can Engage with CCDI

Learn about CCDI, register for upcoming events, and subscribe to our monthly newsletter:
cancer.gov/CCDI

Access CCDI data and resources:
ccdi.cancer.gov

Questions? Email us at:
NCIChildhoodCancerDataInitiative@mail.nih.gov

Thank you for attending!

cancer.gov

cancer.gov/espanol