

Accelerating clinical data management.



We Deliver Better Business Outcomes, Faster

This document describes our desire to work with your organization to accelerate its clinical data management processes. The TrialTwin™ platform can deliver immediate value on a fixed price, fixed timeline basis.

Fast-changing market, regulatory, and reimbursement realities are forcing both sponsors and CROs to change their old ways of doing things. Our take on how clinical trial data management must change is defined in Our End Goal: Accelerate Clinical Trial Data Flow below.

Our approach is to start at the end: helping build faster, cleaner, defensible, more compliant submissions. Our approach is “digital-at-birth”, with a digital end-to-end integrated solution. And with a single source of truth where changes ripple through all downstream processes.

TrialTwin™ is an integrated suite of modules described in detail below, including:

- * Metadata Repository
- * Protocol Manager
- * Synthetic Health Data
- * Open Data Repository

Our software was designed specifically for Life Sciences organizations. We work with a large sponsor to build our software from scratch based on their requirements.

We offer a “done-for-you” service with a very short time to value. Our team performs the heavy lifting. And we make it easy to work with us:

- * implement modules one at a time
- * small, low-budget PoCs
- * incremental build-outs
- * no need for IT involvement

An instance of TrialTwin™ specific to your organization can be operational in a few weeks after receiving a signed PO.

Data Santander is a founder-led company. With no external funding. We're solely customer-funded. You'll work directly with our development team. And we're able and willing to customize TrialTwin™ to better fit your organization's unique needs.

Contact Us

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Our End Goal: Accelerate Clinical Trial Data Flow

We believe the way data is handled during a clinical trial needs to be re-designed from the ground up. That's our goal with TrialTwin™: to incrementally re-design current processes.

Status Quo

The diagram below presents an overview of the steps currently involved in designing and handling data during a clinical trial. There are multiple data transcoding steps, many manual processes, and a large number of very brittle SAS macros that need to be customized for different trials.

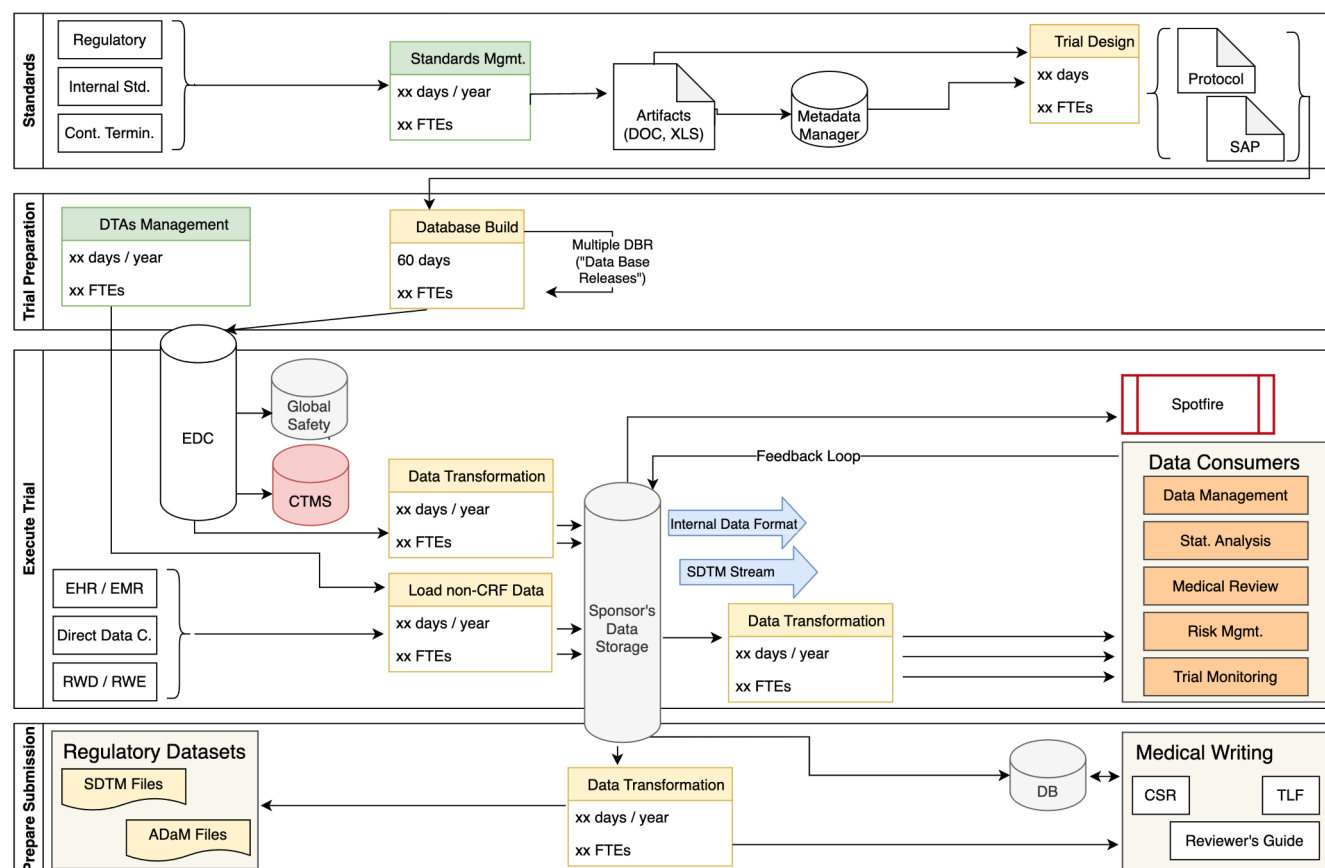


Figure 1: Current state of data flows in a clinical trial.

Many software packages in use today provide a thin layer of digitalization on top of otherwise manual, paper-based processes. Most stakeholders in the clinical trial space are awash in "digital paper."

Instead of trying a novel way to optimize innately inefficient processes, the TrialTwin™ approach eliminates many of the existing processes by building a digital-at-the-start flow.

The diagram below outlines TrialTwin™ as a centralized, metadata-driven platform that eliminates most data transcoding processes and SAS macros.

TrialTwin™ leverages the concept of a “Computable Protocol” (such as that defined by CDISC’s USDM) to drive all the downstream processes.

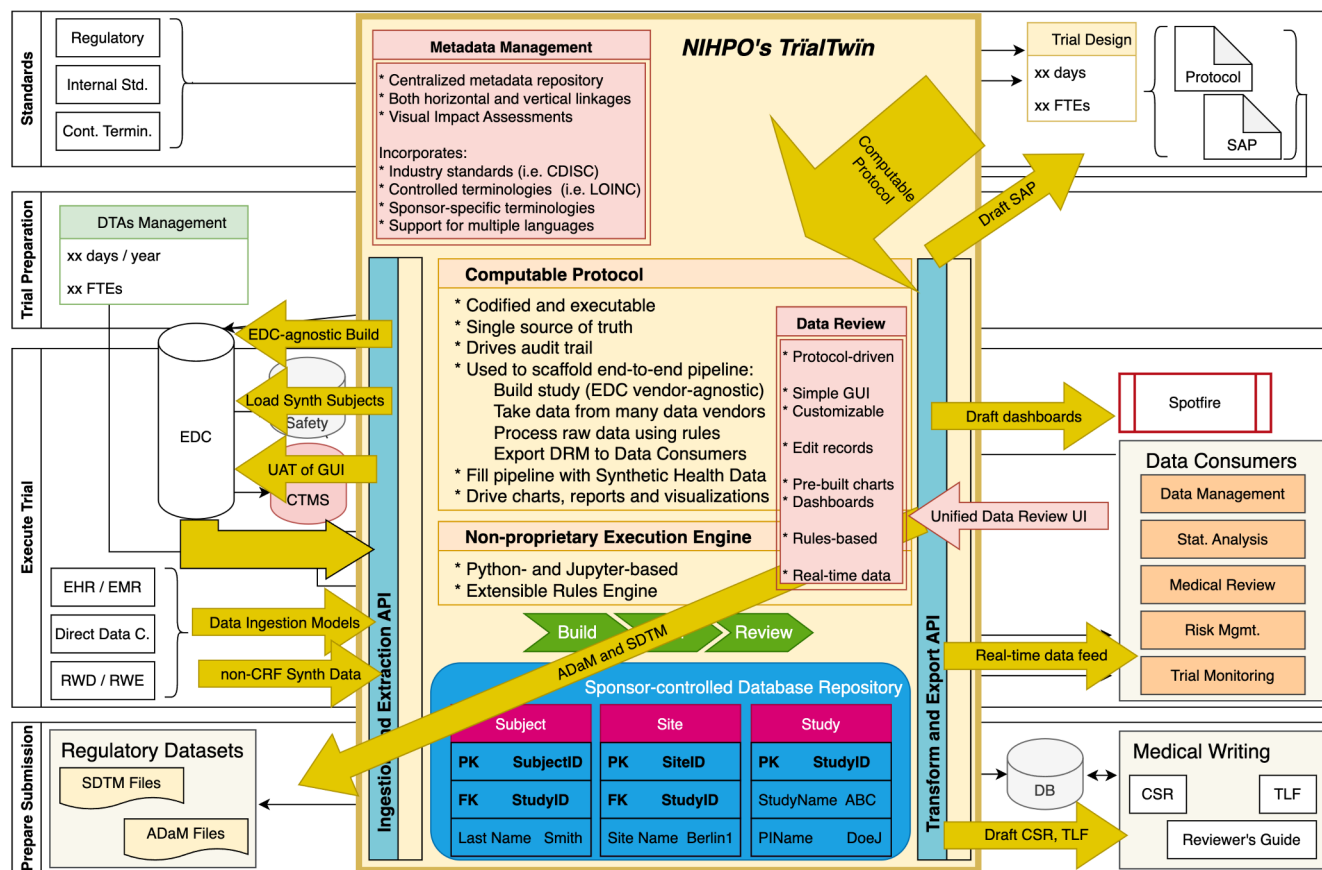


Figure 2: Desired end state of optimized, digital-first data flow.

Metadata Repository

The TrialTwin™ Metadata Repository (“MDR”) module is a visual, integrated manager of data standards & terminologies used in the Life Sciences market.

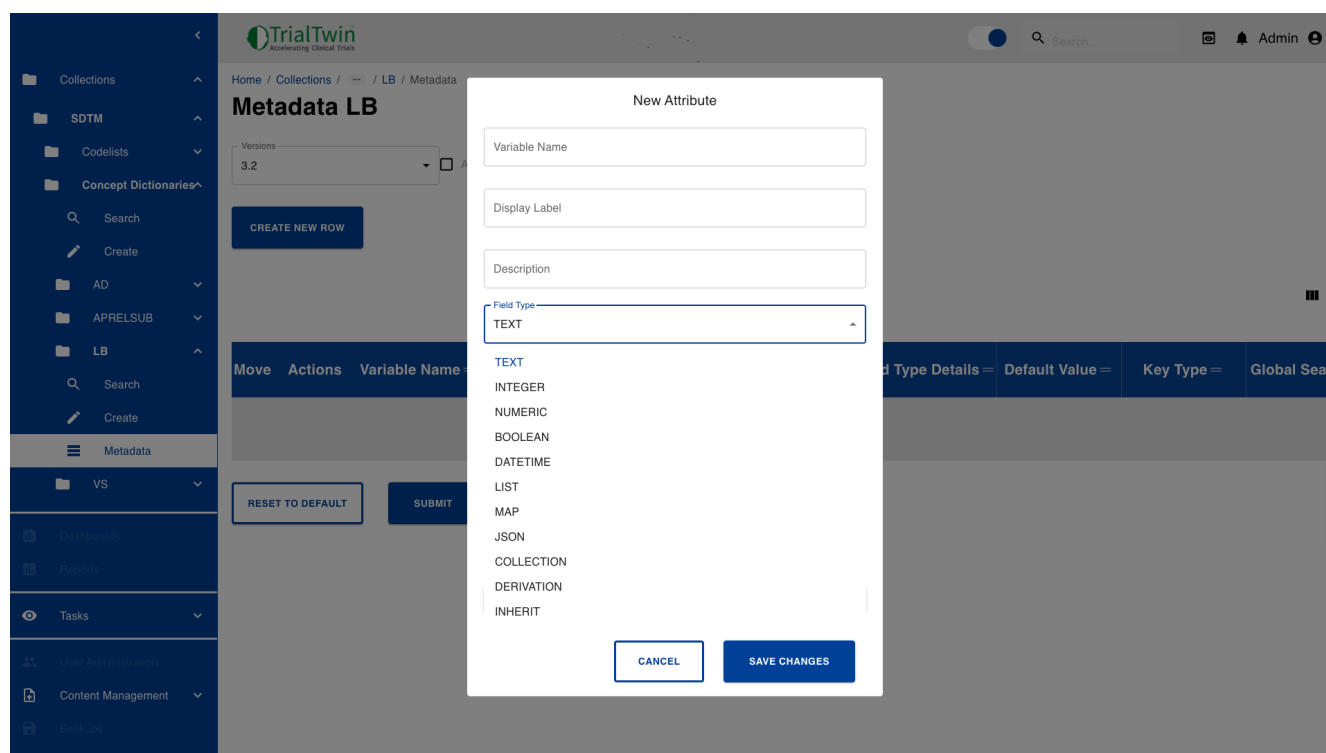


Figure 3: Metadata Repository ("MDR")

These are some of the benefits to sponsors of having access to our MDR:

Table 1: Benefits of MDR.

Benefit	Description
Saves time	No more web searching or looking for Excel trackers.
Centralize Data	Manage terminologies and dictionaries for use across functional areas. With full audit trail.
Item Connectivity	Display and manage relationships between terms, concepts, forms, libraries, up to studies.
User Roles	Access for Searcher, Editor, Approver roles.
Task Pool	Workflow engine for editing and approval.
Impact Assessment	Analyze ripple effect of changes to items.

The TrialTwin™ Metadata Repository (“MDR”) module provides these features:

Table 2: MDR features.

Feature	Description
Hosted	Instant-on, nothing to install and maintain on client’s side.
Pre-loaded industry standards	CDISC; LOINC; and SNOMED-CT are loaded and ready for use. Additional industry standards / terminologies can be loaded on request.
Load client-specific metadata	Client-specific metadata will be loaded to system.
Strict role management	Various roles with different level of permissions to perform actions
Single source of truth	With real time management of controlled terminology and concept dictionaries including audit trail.
Items Connectivity	Display of metadata connectivity in UI.
Impact Assessment	CT update impact to downstream metadata and action based on DISC or sponsor-specific codes.
Task pool management	Mechanism to identify, create, assign, track, and close open Tasks (additions, edits, retirements).
Modern User Interface	Comprehensive search functionality and UI visualization flexibility to rename column names and reposition column as needed.
Quality control process	Workflow for a task and data validation for record creation and maintenance.

Custom Enhancements

Client-specific enhancements can be developed, please ask us for a cost estimate.

Protocol Manager

The TrialTwin™ Protocol Manager module allows sponsors to capture and manage Protocol data in digital format. And to connect the Protocol with sponsor data, once submitted.

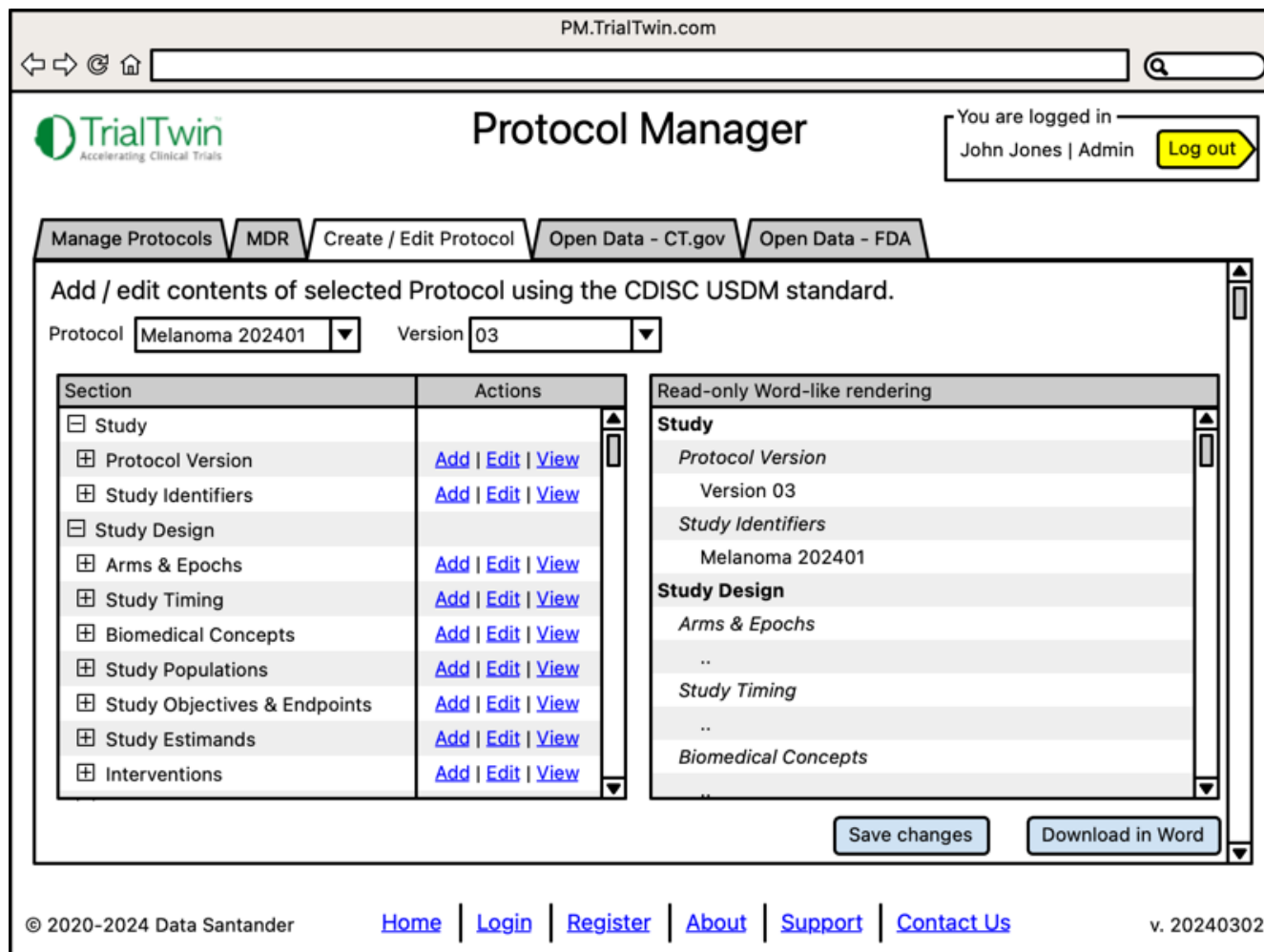


Figure 4: Add / Edit Protocol.

Table 3: Benefits of Protocol Manager


Benefit	Description
End-to-end Digital	Write once, read often across all trial phases. Link to EDC, CTMS
Integrated MDR	Tied to controlled terminologies during protocol design process. Full audit trail.
CDISC USDM	Data is stored natively using USDM standard.

Benefit	Description
Pre-loaded Content	Users access previous Protocols, SAPs, ICFs from ClinicalTrials.gov Used as reference to accelerate protocol creation, management. Reducing user errors.

The CDISC USDM standard is currently supported, We can enhance the system to also support ICH M11 if requested.

User can use the Protocol Manager to view previous protocols and application documents for related products. The Protocol Manager gives medical writer a view into the entire life cycle of previously-approved products.

PM.TrialTwin.com



Protocol Manager

You are logged in
John Jones | Admin

Log out

Manage Protocols

MDR

Create / Edit Protocol

Open Data - CT.gov

Open Data - FDA

Search across all ClinicalTrials.gov data

Condition

Melanoma

Country

United States - US

Status

Completed

Study Start

01/01/2010

to

12/31/2020

Primary Completion

mm/dd/yyyy

to

mm/dd/yyyy

First Posted

mm/dd/yyyy

to

mm/dd/yyyy

Search

NCTID	Title	Sponsor	# Subjects	Protocol	SAP	ICF
NCT03834623	Avadomide (CC-122) in Combination..	H. Lee Moffitt Cancer..	23	Text	Text	Text
NCT02437305	Melanoma Perception and Health..	Northwestern University	100			
NCT02403778	Ipilimumab and All-Trans Retinoica..	University of Colorado..	10	Text	Text	
NCT01752257	EF5 in Melanoma Patients..	Douglas Tyler Varian..	15			
NCT03356470	Pilot Study of Biomarkers..	University of Wisconsin..	5			
NCT02112032	Treatment of Advanced Mel..	Hassane M. Zarour..	43			
NCT05611229	Treatment Patterns and Outcomes..	Novartis Pharmaceuticals	1975			
NCT02120222	Evaluating SINE KPT-330 in..	Kari Kendra	8			
NCT02434354	A Tissue Collection Study of ..	Abramson Cancer Center..	33	Text	Text	

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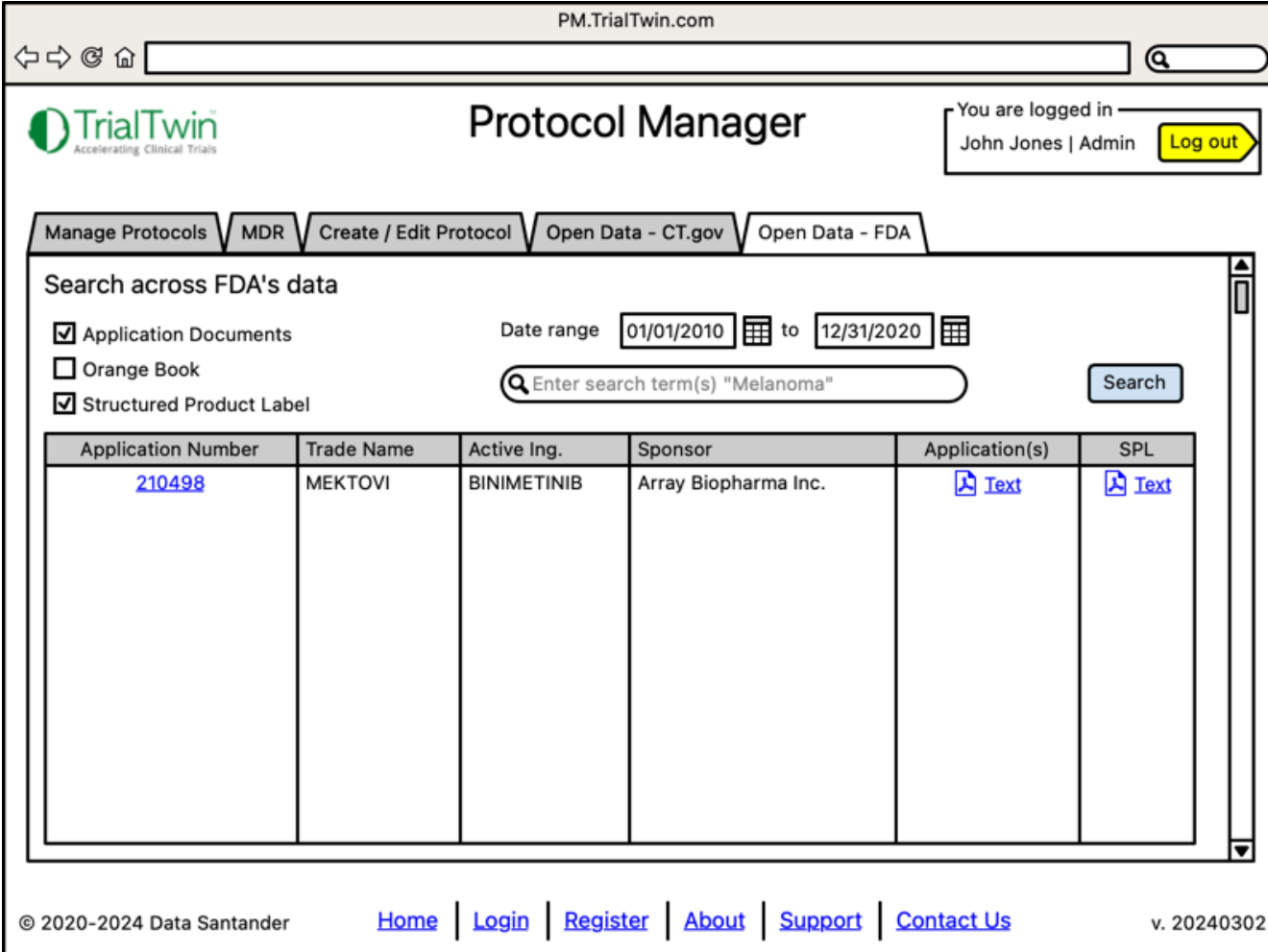
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Figure 5: Open Data - ClinicalTrials.gov

In the above wireframe user can search for and review previous studies targeting the same indication. If available, user can see the actual Protocol, SAP, and/or ICF of each of those previous studies.

In the wireframe below user can review the full application documents, Orange Book, and SPL of previously-approved products.

PM.TrialTwin.com



Protocol Manager

You are logged in
John Jones | Admin

Log out

Manage Protocols

MDR

Create / Edit Protocol

Open Data - CT.gov

Open Data - FDA

Search across FDA's data

☒ Application Documents

Date range 01/01/2010 to 12/31/2020

☐ Orange Book

Search

☒ Structured Product Label

Application Number	Trade Name	Active Ing.	Sponsor	Application(s)	SPL
210498	MEKTOVI	BINIMETINIB	Array Biopharma Inc.	Text	Text

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v. 20240302

Figure 6: Open Data - FDA

Synthetic Health Data

The TrialTwin™ Synthetic Health Data module allows user to generate realistic yet fake data for testing purposes. From the Protocol Manager, user can create study-specific test data in minutes.

Sponsor obviously has access to massive amounts of real data. But there are many use cases (such as when dealing with outside vendors / contractors) when there is a need to request a data waiver. That process usually takes time, and there are limits and restrictions placed on the data.

With Synthetic Health Data the test data is immediately available to all stakeholders, in large numbers, and without any restrictions. Thus accelerating the execution of desired tests and validation processes.

Table: Synth_PHR_Demographics													
	id	Patient_ID *	First_Name	Middle_Name	Last_Name	Gender	Race	Date_Of_Birth	Country_Of_Birth	State_Province_Of_Birth	Location_Of_Birth	Location_Of_Birth_Lat	Location_Of_B
1	603	0017d013-...	NAUSHIR	KONGSAB	KARKEHALLI	M	ASIAN	2003-02-09	United States	Utah	College Ward	41.675876	-111.8779443
2	768	003fa6dd-...	JAMARL	HAN-SOO	TENNAL	M	WHITE	1971-04-18	United States	Illinois	Johnsonville	40.212592	-87.6682441
3	130	00c0d0d7-...	BONGJOON	JINCE	CADEGAN	M	NOT REPORTED	1975-04-05	United States	West Virginia	Gardner Junction	37.3934516	-81.0866469
4	941	00e22265-a412-4cd8-...	CHENG CHENG	SIRAH THOMAS	KINAMI	M	NOT REPORTED	2002-05-17	United States	Kentucky	Fariston	37.071089	-84.0560974
5	974	0156c0cf-f2e8-4c37-...	NA-HYEON	DEOCALLI	MANOUSSELIS	F	AMERICAN INDIAN OR ...	1960-07-31	United States	Ohio	Morristown	39.4125158	-82.1199232
6	904	01b27b11-...	HEIJIN	VICKYANN	ALBETE	F	AMERICAN INDIAN OR ...	1965-09-16	United States	South Carolina	College Heights	34.3782099	-80.0594003
7	280	02b671e7-316c-4928-...	IQUBAL	KERSHAW	OWUSU-MCKENZIE	M	UNKNOWN	1961-12-11	United States	Georgia	Lenox	31.2725768	-83.4623845
8	805	02c2be86-f1a9-452a-...	VALLEY	JOHN PHILAMER	CHALVADAKIS	M	NOT REPORTED	1985-05-29	United States	Indiana	Mount Auburn	39.8123242	-85.1891872
9	741	02e07c71-36f9-4429-...	ZERLY	TAYLIAH	LABABIDY	F	NOT REPORTED	1995-07-23	United States	Nebraska	Page	42.4003369	-98.4153022
10	142	03062ee7-9c41-4ef0-...	ZEDEENA	MAJO	NARDUCCIE	F	NOT REPORTED	2001-02-25	United States	Montana	Ridgelaun	47.7919621	-104.0868229
11	516	030b93ec-...	ANANIAS	JIVONY	ZESZUT	M	ASIAN	1967-11-11	United States	Ohio	Shobers Mills ...	0.001	0.002
12	844	03873d17-718b-4386-...	MAATI	SUDHARMA	ROBILOTTA	F	UNKNOWN	1947-02-09	United States	South Dakota	Huron Colony	44.5644242	-98.2062586
13	594	03962d7e-...	SELORM	BBIMAZ	NIMOITYN	F	BLACK OR AFRICAN ...	1997-02-12	United States	Florida	Pompano Park	26.1982502	-80.2083805
14	968	03ec43ab-bdf4-4172-...	WILLIAM (BILL)	SHAKELL	PASTORIZA	M	BLACK OR AFRICAN ...	1968-12-18	United States	Washington	Chillowist	48.303039	-119.6355008
15	645	049b4cfa-...	XAYDEN	TYQUINE	DING	M	BLACK OR AFRICAN ...	1949-11-02	United States	Mississippi	Rolling Heights ...	30.4437752	-88.9137826
16	445	04beecb0-794e-48fb-...	MALEEA	AMAIRANY	TOOMIN	F	BLACK OR AFRICAN ...	1948-08-03	United States	Arizona	Cheyenne Village	33.5980403	-112.136208
17	847	050172ab-...	ARWIN ANGELAE	TESEN	RICCIO-HUCK	F	AMERICAN INDIAN OR ...	1986-12-03	United States	Virginia	Ardmore	37.3461907	-79.9353175
18	82	0504391e-...	XUYEN	RHUSHI	JACKSON GRUEB	M	NATIVE HAWAIIAN OR ...	1942-05-10	United States	Texas	North Uvalde ...	29.2371272	-99.7997795
19	1000	05462177-6bba-4616-...	JITRUDEE	RENITRA	BENUTO	F	AMERICAN INDIAN OR ...	1939-02-25	United States	Florida	Mandolin	28.0644	-82.619
20	595	05578fde-...	ROOLS	ATAT	FARNADY	M	UNKNOWN	1968-07-30	United States	Texas	Mays Crossing	28.3458631	-98.0608945
21	905	055d3abf-0767-413c-...	SIRISUDA	SHERI-RAE	SCAVONE	F	BLACK OR AFRICAN ...	1984-04-29	United States	Washington	Mead	47.7648923	-117.353439
22	923	05849699-...	DY	HOUKUN	LADOVSKY	M	BLACK OR AFRICAN ...	1961-09-04	United States	Delaware	McDonalds ...	38.6651139	-75.4489203
23	626	05d75b47-1578-4b10-...	JERELL	VELDIN	GLANTON-...	M	WHITE	1952-08-27	United States	Michigan	Riverview Estat...	44.891	-83.4347222
24	807	05dc078f-7d95-4fba-...	MOMOLU	BYUNG SOO	MABEN-FASTER	M	ASIAN	1943-07-31	United States	Alabama	Philadelphia	31.1615134	-85.1054299
25	78	05de6106-39ef-40bd-...	KYUNOMI	RATONA	LOEBL	F	NOT REPORTED	1975-03-10	United States	Florida	Azalea Park	28.5406128	-81.2991237
26	70	05fe9ffa-...	YATISH	MOHAMMED ...	AGBI	M	WHITE	1962-10-07	United States	Texas	Carr	28.7343267	-96.7539808
27	244	06551305-bf12-43cc-...	CHRIS	YUNSUK	MAYMIND	M	ASIAN	1990-02-15	United States	Minnesota	Tyler	44.2772965	-96.132255
28	406	0660e0ed-b697-4bcd-...	DAINELL	ANYLLAH	KUBOJIRI	F	UNKNOWN	1938-11-02	United States	Kentucky	Jones (historical)	37.3619805	-83.2323765
29	386	0679cdf8-ef6a-45bd-...	DAYNA CARMEN	WASHAUNDRA	BUSICO	F	BLACK OR AFRICAN ...	1941-11-02	United States	Tennessee	Blount Beach ...	35.7859368	-83.8851344

Realistic yet fake full name

User-defined age range, and gender, race %.

Real city / town. With Latitude, Longitude for mapping.

SD1629 | RWD + Synth Data => Predictions | USConnect23 4

Figure 7: Synthetic Health Data - Demographics

Table 4: Benefits of Synthetic Health Data

Benefit	Description
Realistic yet Fake	Data is realistic (using terminologies like LOINC, SNOMED) yet totally fake. No de-anonymization risk is a significant benefit.
Test Earlier	Synthetic Health Data helps teams to test code and processes earlier. And cover corner cases.
Fast, Low-cost	Large quantities of data can be created quickly and at low cost. Use

Benefit	Description
	multiple times.
CDISC Formats	SDTM-formatted data is available now. ADaM datasets can be easily generated on request.

The Synthetic Health Data can also be used to test tools for changes in rules. As well as creating tools and visualizations to make users' work more effective

Furthermore, as sponsors are expected to ingest more Real World Data ("RWD"), test data can be used to test and validate ingestion tools. For example, large amounts of test data in the FHIR format will be useful to validate of current tools can ingest these new types of data.

Synthetic Health Data can be used to safely and quickly develop new data management activities.

Table: Synth_PHR_Conditions

id	Patient_ID	Event_Date	TermID	TermName	UMLS_CUI	Occurrence	Usage	NIHPO_Hierarchy
1	14ccc262-83ce-4580-8f47-b23f3ee1ecf	1979-09-12	73181007	Recurrent pterygium (disorder)	C0155158	1.0	0.0004	disorder
2	14ccc262-83ce-4580-8f47-b23f3ee1ecf	2019-07-24	70637004	Cellulitis of toe (disorder)	C0263134	2.0	0.0032	disorder
3	14ccc262-83ce-4580-8f47-b23f3ee1ecf	1994-09-09	59214008	Reduction mammoplasty (procedure)	C0191922	1.0	0.0003	procedure
4	14ccc262-83ce-4580-8f47-b23f3ee1ecf	2017-12-25	370143000	Major depressive disorder (disorder)	C1269683	3.0	0.0228	disorder
5	14ccc262-83ce-4580-8f47-b23f3ee1ecf	2010-10-14	304026004	Varicose ulcer of lower extremity (disorder)	C0553570	2.0	0.0021	disorder
6	47d3ac87-57a7-4f37-a1cb-1c6ce74f4cfc	1961-07-29	389026000	Ascites (disorder)	C0003962	7.0	0.0283	disorder
7	47d3ac87-57a7-4f37-a1cb-1c6ce74f4cfc	2020-04-07	274769005	Albuminuria (finding)	C0001925	2.0	0.003	finding
8	47d3ac87-57a7-4f37-a1cb-1c6ce74f4cfc	1996-08-19	62479008	Acquired immune deficiency syndrome (disorder)	C0001175	6.0	0.0304	disorder
9	47d3ac87-57a7-4f37-a1cb-1c6ce74f4cfc	1999-03-02	26947005	Open wound of lower limb (disorder)	C0178323	2.0	0.0027	disorder
10	47d3ac87-57a7-4f37-a1cb-1c6ce74f4cfc	1948-04-26	1055001	Stenosis of precerebral artery (disorder)	C0265089	1.0	0.0022	disorder
11	21b07450-c530-49cb-a5f3-144031eedf90	1959-01-30	48167000	Amnesia (finding)	C0002622	6.0	0.0597	finding
12	21b07450-c530-49cb-a5f3-144031eedf90	1972-08-04	63079007	Closed traumatic dislocation of hip joint (disorder)	C0434662			disorder
13	21b07450-c530-49cb-a5f3-144031eedf90	2006-04-17	34068001	Heart valve replacement (procedure)	C0190173	4.0	0.002	procedure
14	21b07450-c530-49cb-a5f3-144031eedf90	1944-01-26	91857003	Acute lymphoid leukemia,disease (disorder)	C0023449	4.0	0.0059	disorder
15	21b07450-c530-49cb-a5f3-144031eedf90	2005-06-27	254588001	Polyp of intestine (disorder)	C0021846	1.0	0.0004	disorder
16	9460981d-e87d-4c26-aedd-e811008eb00e	1973-08-20	235159007	Percutaneous endoscopic insertion of gastrostomy tube ...	C0176751	2.0	0.0009	procedure
17	9460981d-e87d-4c26-aedd-e811008eb00e	1967-09-09	48194001	Pregnancy-induced hypertension (disorder)	C0852036	4.0	0.0225	disorder
18	9460981d-e87d-4c26-aedd-e811008eb00e	1963-07-07	60826002	Coccidioidomycosis (disorder)	C0009186	1.0	0.0006	disorder
19	9460981d-e87d-4c26-aedd-e811008eb00e	1988-11-16	36995006	Drainage of external ear (procedure)	C0198018	1.0	0.0003	procedure
20	9460981d-e87d-4c26-aedd-e811008eb00e	1967-02-06	202482009	Wrist joint pain (finding)	C0221785	1.0	0.0009	finding
21	15df90b8-2d57-49d1-8ad5-600f695c64b5	1900-12-08	53627009	Closed fracture of radius AND ulna (disorder)	C0272624	1.0	0.0034	disorder
22	15df90b8-2d57-49d1-8ad5-600f695c64b5	2009-04-10	429699009	History of malignant neoplasm of colon (situation)	C1998265	5.0	0.0232	situation
23	15df90b8-2d57-49d1-8ad5-600f695c64b5	2011-10-26	266609001	Female infertility of anovulatory origin (disorder)	C0404572	2.0	0.0009	disorder
24	15df90b8-2d57-49d1-8ad5-600f695c64b5	2016-09-07	206118007	Fetal or neonatal effect of disproportion during labor and ...	C0473841	1.0	0.0061	disorder
25	15df90b8-2d57-49d1-8ad5-600f695c64b5	2021-01-16	236443009	Medullary sponge kidney (disorder)	C0022681	1.0	0.0005	disorder
26	8bc6fa31-57c2-4dd5-b600-16e29dd7728d	1997-11-21	6240004	Operative procedure on knee (procedure)	C0187769	1.0	0.0007	procedure
27	8bc6fa31-57c2-4dd5-b600-16e29dd7728d	2014-09-12	92258000	Benign neoplasm of orbit (disorder)	C0154023	1.0	0.0005	disorder
28	8bc6fa31-57c2-4dd5-b600-16e29dd7728d	1988-03-14	242489002	Accident due to contact with hot or corrosive substance ...	C0417508	1.0	0.0005	event

SNOMED-CT codes

Full concept description

UMLS CUI code included as well

SD1629 | RWD + Synth Data => Predictions | USConnect23 5

Figure 8: Synthetic Health Data - Conditions.

Our Synthetic Health Data helps your organization to

- * Test earlier: start testing as soon as the first drafts of the Protocol are ready
- * Test often: re-run the test data through all your processes as often as necessary
- * Test fully: our data is large enough to cover all possible corner cases and possible choices

Open Data Repository

Users can track every drug, manufacturer, and the individuals behind the documents submitted to government agencies.

The Repository allows users to trace an approved drug's lifecycle:

- * Starting with chemical compounds (NLM's PubChem)
- * Through clinical trials (ClinicalTrials.gov, WHO's ITPR)
- * Documentation on regulatory pathway (IND, NDA, etc.)
- * Reported adverse events (FDA's FAERS, MAUDE)
- * Manufacturer payments to providers (HHS' OpenPayments)
- * Medicare reimbursement data (CMS' Provider Utilization, Payment Data)

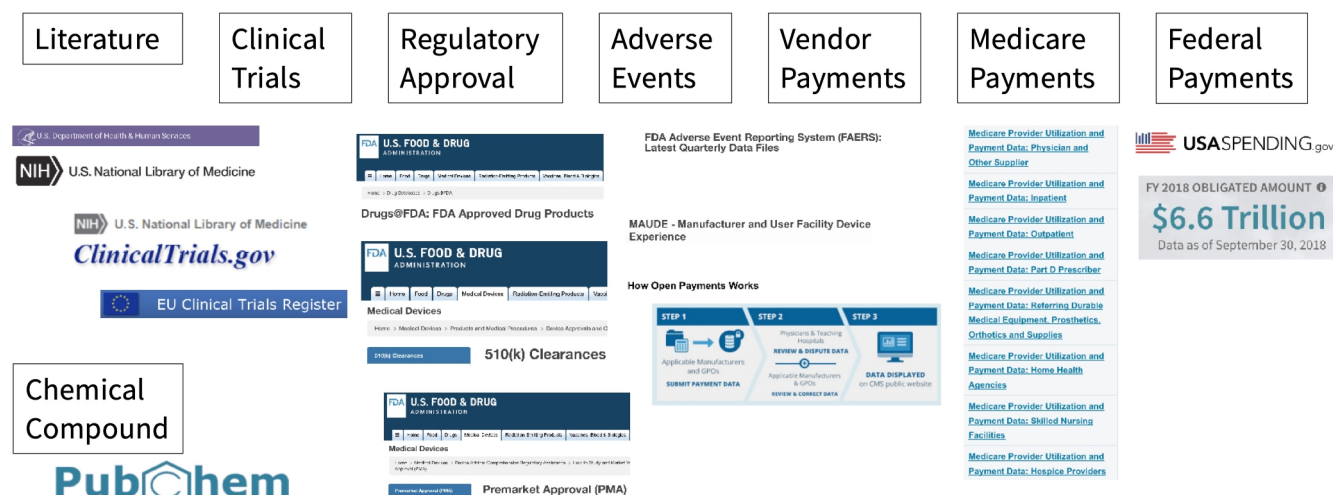


Figure 9: Open Data Repository.

The Repository offers users a 360 degrees view of each previously-cleared drug.

Open Data to Train AI, ML

The data stored in the Open Data Repository module can be used to train AI / ML models. Think about these data as the “Ground Truth” of what has happened in the pharma space in the US for the last 30 years.

Users can leverage Life Sciences-specific Open Data including:

- 40,000+ Protocols, SAPs, ICFs
- over 70,000 FDA application files
- 110,000 full FDA labels (“SPL”)

Users can use this data to train their Models with the text extracted from all those documents, containing 600+ million words.

We can also include additional Open Data from other US agencies, including:

- CMS – Medicare
- HHS – healthcare
- NLM – references

About TrialTwin™

TrialTwin™ is developed by:

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39010 Santander, Cantabria
Spain

Data Santander is a small software development company that provides outside, unbiased suggestions and innovative approaches to tackle data management challenges for our Life Sciences clients.

Compared with larger vendors, at Data Santander we are:

- * **fast** – clients work directly with our developers to reduce cycle times
- * **fearless** – we want to eliminate, rather than improve, most processes in clinical data management
- * **flexible** – we're able to make progress while requirements are defined on the fly
- * **friendly** – we love what we do, and we bring our quirky personalities to the job
- * **fun** – life's too short so we make working with us fun and enjoyable

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