CDD VAULT®
Complexity Simplified

Customer Case Study

"With each cycle we're learning more about what makes a good drug for a specific virus. The efficiencies of CDD Vault help expedite decisions."
Ava Vargason, READDI Project Manager, University of North Carolina at Chapel Hill

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL
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Antiviral Researchers at University of North Carolina at Chapel Hill READDI Speed Drug Discovery with CDD Vault

Situation

The Rapidly Emerging Antiviral Drug Development Initiative (READDI) is dedicated to preventing global catastrophes caused by viruses. Founded in 2020 at the University of North Carolina at Chapel Hill by Drs. Nat Moorman, Ralph Baric, and Mark Heise, READDI is a collaborative initiative that brings together academia, industry, and non-profits to develop antiviral therapeutics.

Specifically, READDI's mission is to ensure that broad-spectrum small molecule antiviral drugs are ready for immediate use at the first signs of future pandemics. READDI leverages the skills, resources and operational expertise of academia and industry to efficiently discover and develop medicines before devastating new viruses emerge.

The NIH awarded a $65 million grant to establish an Antiviral Drug Discovery (AViDD) Center at UNC Chapel Hill under the READDI mission. As one of nine Centers, the READDI AViDD Center (READDI-AC) manages research data across more than 40 labs at 23 different institutions in the US and abroad.

Early in the process the READDI-AC team realized they would need a powerful informatics platform to serve as a central repository for data that was arriving via Excel spreadsheets, PowerPoints, and other email attachments.

Solution

READDI deployed Collaborative Drug Discovery's CDD Vault, the hosted drug

READDI serves as a major research center for the AViDD search for small-molecule antivirals.

discovery informatics platform that securely manages both internal and external biological and chemical data.

"With 40 different labs on the AViDD grant, we have collaborators all over the globe," says Ava Vargason, READDI Program Manager, Eshelman Innovation, University of North Carolina at Chapel Hill. "One of the problems we identified early on was that most of our work is driven by chemists who are collecting data from biologists, virologists, enzymologists, and other disciplines. They look at that data and then make decisions on what to do next."

"When we started this project, there was no formal database to handle all of the data, so we were keeping track of it in Excel spreadsheets and emailing around PowerPoint files and everything," recalls Peter J. Brown, Research Project Manager, Eshelman School of Pharmacy, University of North Carolina at Chapel Hill. "We had to extract the information from PowerPoint files and put it in an Excel spreadsheet. It quickly became evident that we were going to lose our sanity doing this."

The challenge was to find the best way to manage all the data.

"Originally we planned to build our own database, host it internally at UNC, and that would be our solution," Vargason says. "I'm sure we aren't the first people to go down this path, but after about 18 months of trying to structure everyone's data in a similar format, without requiring too much ongoing manual labor, we ran into all kinds of problems, including the errors that come when just a single cell in an Excel spreadsheet is off. We kind of threw up our hands and looked for commercial solutions."

Describing the difficulty of trying to create their own platform, Vargason says: "Because we have labs over a spectrum of disciplines, each

person's data is unique to their lab. Early on, we were trying to impose as little structure as possible, but what we quickly found was that we were sending thousands of chemical compounds to labs across the world, and because we didn't have a structured searchable database, we couldn't answer even simple questions such as what compounds had been tested in different experiments."

Vargason recalls: "It became clear to us that to build our own solution from the ground up we would have to go into each lab, study their data structure and then try and build something from scratch that would help us merge all these things together, and then actually do the technical back end of coding, while making sure that it works, because if you have an error such as the wrong piece of data getting associated with the wrong compound, it becomes a huge problem. We needed a robust system that would give us a single version of the truth."

"At that point we decided to look for a commercial solution," Vargason says. "And that's how we found CDD vault."

The READDI team considered other databases, but was impressed with the robustness plus ease of use of CDD Vault. Vargason also notes: "CDD Vault came highly recommended from multiple investigators working on the AViDD project."

Benefits

The READDI AViDD team has found a number of benefits since adopting CDD Vault, including:

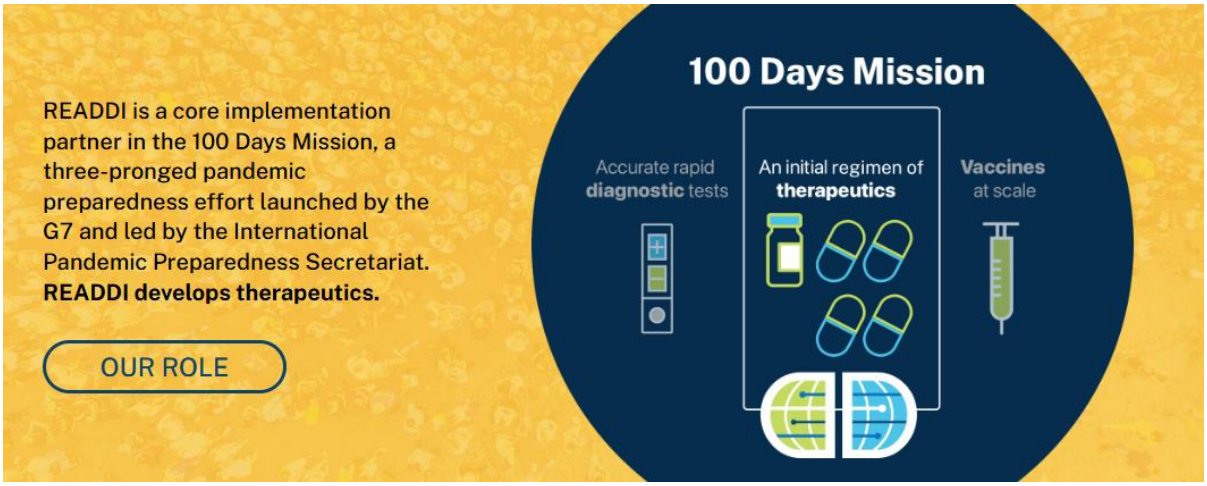
- A central repository and "Single Source of Truth"
- CDD Vault is "Purpose Built" … "Chemist Friendly"… and "Becoming an Industry Standard"
- Slashing data administration time by nearly 90%
- Flexible searchability
- Powerful visualization
- Speeding time to drug discovery
- CDD Vault inventory function
- Robust IP protection
- CDD is a great company to work with

CDD Vault Provides a Central Repository and "Single Source of Truth"

Deploying CDD Vault has provided a unifying central repository for research data across all the labs, including the geographically dispersed research centers—relieving anxiety along the way.

"Prior to deploying CDD Vault, we would worry about things like an index match function being off," Vargason says. "Concerns like that kept me up at night with our old system—the fear that we were going to make chemistry decisions based off a spreadsheet and then find out months later that data had been incorrectly merged. With CDD Vault's registration and unique identifiers, we have confidence that it is related to the compound it is linked to. There's also no more worry about finding the most recent spreadsheet. CDD Vault provides us with a single source of truth."

Anirban Ghoshal, Postdoctoral Research Associate, Eshelman School of Pharmacy, University of North Carolina at Chapel Hill, appreciates CDD Vault's role as a searchable and secure central repository.



"Previously, I had to pull down the data from different files and then try to accumulate and adjust them in an Excel sheet," Ghoshal. "With CDD, all of the data is right there. You can pull all the data you need to compare compounds."

Ghoshal also values the historic data CDD Vault stores.

"It really helps that assays, protocols, and associated data are all stored in one place," Ghoshal says. "In our AViDD project, we can have multiple registrations for a single compound, meaning we can see all the data from one place, including the duplicates and how many replications were done."

Ghoshal finds this helpful when studying dose response for each compound, across multiple assays.

"CDD stores all the data that has been done for a compound," Ghoshal says. "It really helps to have everything in one place, rather than having to pull data from different files at different times. With the Vault, you have the data for all versions of a compound in one place, and you can see them together."

Brown also values the historical data that CDD Vault provides.

"In our registry system we register compounds as different batches, because the first batch is where you have a hit from a screen," Brown says. "The second batch is where you've either reordered the compound or remade it in the lab to check for its activity. CDD Vault keeps track of all the different batches so when the data is presented in the final table, it's sorted by batch number. This lets you see if the activity changes between the different batches. CDD makes this even easier to see through its visualization."

CDD Vault is "Purpose Built" … "Chemist Friendly"… and "Becoming an Industry Standard"

AViDD researchers, many of whom already had experience with CDD Vault, were quick to embrace deployment of the informatics platform.

"One of the biggest benefits of CDD Vault is that it's purpose-built for drug discovery," says Robert Smiley, Bioinformatics Systems Analyst at the University of Alberta, and a participant in the AViDD study. "We had tried an earlier

database, but it was a more generic database and we found that we had to fight every step of the way to do things such as averaging different IC50 values for duplicate compounds, that CDD Vault does instantly. Our scientists seem to really like CDD Vault because it is more suited to their needs and has the kind of features that they're looking for. Most of the collaborators I've worked with have been using CDD Vault. It seems like it is becoming an industry standard."

Brown at UNC agrees.

"We started looking at different solutions and CDD bubbled to the top because it was the most chemist friendly," Brown says. "It lets us indicate structural information, integrate activity data, write protocols to import any type of data we want, and it's extremely flexible."

Slashing Data Administration Time by Nearly 90%

Deploying CDD Vault has slashed the time spent on data administration across the AViDD project. Vargason has found that CDD Vault has cut the time she spends managing data by nearly 90%.

"Prior to CDD Vault I was spending at least half my week getting data from researchers, trying to structure that data and merge it all together," Vargason says. "I've reduced the time I spend on such tasks from more than 20 hours a week to just a few hours per week."

Looking at another metric—time spent searching for data, the time savings are even greater. Vargason points to a conference call with researchers from four labs that were running different experiments against a commercial library of 14,000 compounds—looking for the top candidates to focus on.

"We were tasked with going from 14,000 structure-blinded compounds in the Vault, down to our top eight," Vargason says. "On the conference call researchers were asking about different parameters, like 'Do we have something less than 10 micromolar in this experiment as well as that one?' I was at my keyboard on the call, just putting in different queries to CDD Vault. We got down to 55 compounds, and then entering additional search criteria, found our top eight candidates. We did this in real time. Participants on the call were impressed with the efficiency of the process. It was a great validation of our decision to go with CDD Vault."

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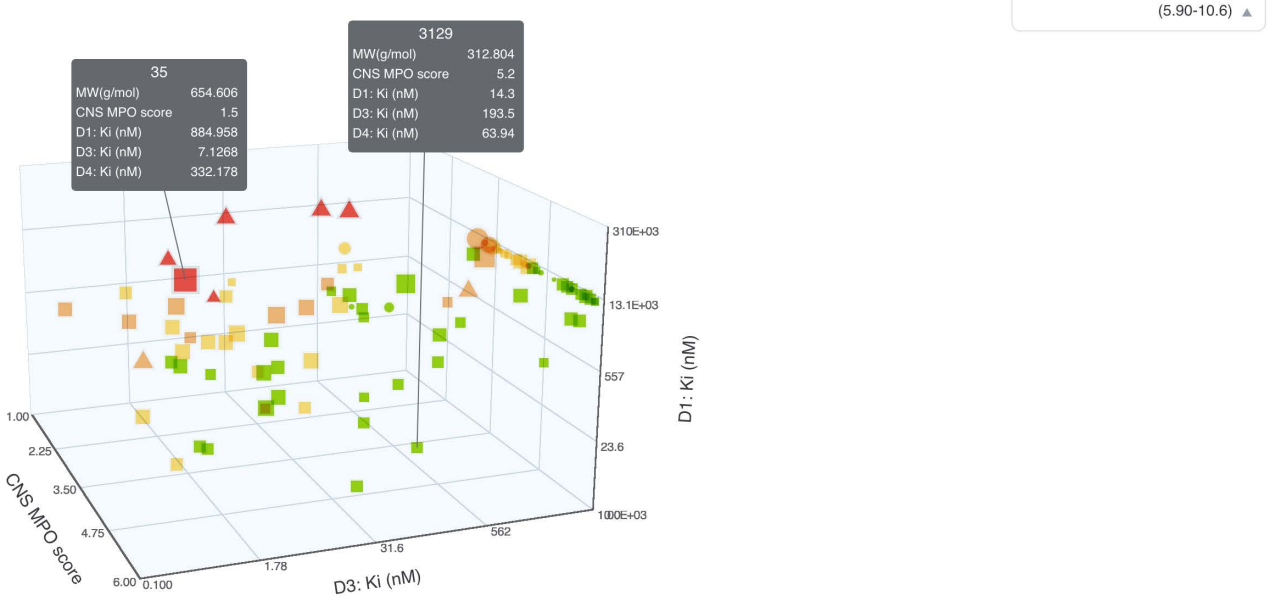
Flexible Searchability

Researchers on the AViDD project appreciate the power and flexibility built into the search capabilities of CDD Vault.

"The search feature is really flexible," Brown says. "The search box allows you to search for



CDD Vault visualization provides immediate insight into activity and relationships.

Made with CDD Visualization

anything—by keywords or registry number, or protocol, and a range of other filters. You can search by substructure, which for a chemist is obviously very important. You can look at a specific hit from an assay, and then search for closely related compounds that were active. It also accepts all sorts of input. For example, you can copy and paste SMILES, so it is very chemistry friendly in terms of searching capability."

"I like the ability to select different fields, as well as the different operators to apply to them," Smiley says. "For example, it is nice to be able to search for IC50 that's greater than a certain value when evaluating molecules. Biochemists love to be able to browse through the molecules and see side by side the chemical structure and all the experimental data."

Powerful Visualization

Across its geographically dispersed labs, the READDI AViDD team is making good use of the powerful visualization features of CDD Vault. Vargason finds it especially helpful when tracking results from a SAR campaign.

"When our chemists are doing new SAR campaigns, one of the things we want to know is how well our different experiments are agreeing with each other," Vargason says. "If a compound is inactive in one experiment, is it similarly inactive in a second experiment?"

"With CDD Vault we can pull all compounds from a given SAR campaign, which we store as collections," Vargason continues. "We can pull all of that into visualization, and immediately see the relationship between, let's say, our cell-based activity against live virus versus the

activity against a single function of that virus from target-based experiments."

Vargason likes the speed and simplicity.

"The built-in visualization makes it really easy to get answers through visualization, without needing to export the data, input it into a third-party application and re-graph it," Vargason says. "We can get answers much faster using CDD Vault visualization."

Vargason also likes using the CDD Vault Curves module, and the ability to set X and Y axis parameters.

"When our labs are looking, for example, at dose-response curves generated by CDD Vault, we can set upper and lower thresholds for the protocol," Vargason says. "You could set the Y axis from -15 to 120—or any other range—for percent inhibition. This is helpful as otherwise it can be visually misleading if the Y axis changes on every single one of your rows."

Researchers also like the flexibility of data analyzed with CDD Vault visualization.

"It helps in CDD, that you can select what you want on your X axis and what you want on your Y axis, and the visualization appears immediately," Ghoshal says. "This makes it easier to see what is going on with a compound across a range of factors."

The thumbprint views of the Curves module have also proven helpful.

"One interesting thing about CDD Vault is the ability to view dose responses," Brown says. "Looking at dose response, for example, you can combine your columns for concentration and percent activity, and CDD will show you what the curve looks like. Or you can ask it to show you a thumbprint of how that curve looks."

"This is important from a chemistry point of view, because quite often, if you just rely on the numbers, you can get a wildly potent compound of five nanomole, but it only inhibits 5% of the activity," Brown says. "A visual representation of such data is powerful. A nice sinusoidal representation provides more comfort that the figures are actually representing the potency of a compound."

Speeding the Time to Drug Discovery

Having CDD Vault as a powerful and easy to use central repository with powerful search and visualization features helps the READDI AViDD labs speed their time to drug discovery.

> ***"CDD Vault is a very good platform that definitely helps our drug discovery efforts."***
> **- Anirban Ghoshal, Postdoctoral Research Associate, Eshelman School of Pharmacy, University of North Carolina at Chapel Hill**

Vargason notes that much of the research work is iterative: "We send compounds to labs, the labs test them, send data back to the chemists, and then the chemists look at that data, and make decisions about the next batch of compounds that they're going to buy or make, and then the whole process starts again. Any delays or friction in any of these steps combine to slow the flow of research."

"The goal is to improve on each batch so that we're getting a better antiviral compound every

time those chemicals go out," Vargason says. "With each cycle we're learning more about what makes a good drug for a specific virus. The efficiencies of CDD Vault help expedite decisions. By simplifying the data sharing process and the data searching process, chemists are able to drive those decisions a lot faster, because they don't have to do some of the slower, more manual work that we were doing before."

Ghoshal agrees.

"As a chemist we always face decisions on what to make next," Ghoshal says. "The quicker you can analyze and visualize the data from compounds you make in the lab, the quicker you can make the decision what to make next—including the decision on what not to make. I believe CDD Vault is a very good platform that definitely helps our drug discovery efforts."

CDD Vault Inventory Function "Really at the Heart of it All"

The CDD Vault Inventory module enables rapid location of samples, reagents or compounds, and supports structure-based searches and queries across custom fields. For chemistry, Vault inventory provides comprehensive compound documentation, chemical library organization and hierarchical tracking from parent compounds to individual samples. For biology, Vault Inventory provides logging with biological materials, detailed tracking for cell lines and tissues and customizable metadata fields.

"The inventory function is really at the heart of all of it because so much of our testing data is on molecules that are in the inventory," Vargason says. "The inventory gives us the ability to track things such as whether a compound was purchased or synthesized. It answers questions like: Do we have multiple batches of it? How was it originated? Was this from literature? Was it from a collaborator? Is it a brand new synthesized compound that came out of one of our own labs? We can track all of that information, which is really useful to have later down the line. And we can also see exactly where a compound is stored in our labs."

Robust IP Protection

Protection of intellectual property is always a concern with drug discovery. The READDI AViDD team likes the inherent security of CDD Vault, as well as the robustness and granularity of its data repository.

"We are striving to create new drugs, and when something emerges from AViDD and we go to file IP, it's important that we have a clear lineage of where that data came from," Vargason says. "We need to be able to show when we synthesized a molecule, when we tested it for the first time, and all the work with it since. CDD Vault puts all that information at our fingertips."

The READDI AViDD team likes that CDD Vault can also store unstructured data.

"We can have the data structured in the database, but we can also attach unstructured data, like the raw data straight off an instrument, or pictures of plaques on a plate. You can actually attach those, either within the database or just on a run," Vargason says.

The granularity of CDD Vault enables deep dives into how the data was created.

"With Vault we can track all the way back to the raw data, which is important," Vargason says. "If there should ever be questions about how

something was this calculated, or whether someone normalized a value incorrectly, we can actually go back and check that. Having all of your data organized in one spot, and not having to rely on someone's personal Google Drive or something, is great for protecting IP."

CDD Is a Great Company to Work With

The READDI AViDD team has found CDD to be a great company to work with—from initial contact clear through post deployment.

"One of the deciding factors for choosing CDD Vault was that that CDD gave us a free trial so we could use a sandbox to make sure the Vault was going to work for us," Vargason says. "Competitors we spoke with didn't offer this. They wanted us to sign a contract without giving us the chance to first make sure it would meet our needs."

Since deployment, Vargason says the team has been impressed by new features and enhancements that CDD regularly pushes out to Vault users.

Customer support has also proven impressive. "Customer support is very important for labs that are trying to work as swiftly and efficiently as possible," Smiley says. "I recently had a question when uploading some data and CDD customer support was very responsive."

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About Collaborative Drug Discovery

Collaborative Drug Discovery provides a modern approach to drug discovery informatics that is trusted globally by thousands of leading researchers. Our CDD Vault is a hosted informatics platform that securely manages both private and external biological and chemical data. It provides core functionality including chemical registration, structure activity relationship, inventory, visualization, and electronic lab notebook capabilities. For more information, visit us at www.collaborativedrug.com.