**Vaccine Distribution System:**

**Problem Statement:**

The existing system for vaccine distribution was highly decentralized and consisted of a patchwork of stand-alone computer applications and paper-based systems operated by the CDC and state and local immunization providers. With significant levels of variation, what emerged over time was a sprawling, highly complex, and fragmented supply chain that left the national government with little visibility over vaccine supply, challenging the CDC’s capacity to effectively and efficiently respond to increasing vaccine shortages and other public health emergencies.

A key requirement to ensure that vaccine was flowing to the right places at the right time is the need for full visibility of the whole supply chain, from manufacturer’s supply in transit to vaccine at destination and all points in between.

The objective is to build a vaccine inventory management and distribution system that will operate at the national, state and local levels .

**Key Entities:**

* Centre for Disease Control (CDC): is responsible for taking orders from PHD and approving them based on the state allocation and then passed on to national distributor for shipping directly to hospitals, pharmacies, clinics, etc.
* PHD (Department of Public Health): Receives orders from registered sites. It is responsible for reviewing and approving site requests for vaccine.
* Distributor: A single national distributor responsible for shipping to registered clinics and hospitals. Satellite clinics receive their supply from their affiliated hospitals.
* Provider: Prepares and submits orders to the PHD for approval. The distributor will ship directly to the site. Maintains vaccine inventory for its satellite clinics. Provider billed by the distributor
* Manufacturer : Manufacturers vaccines and supplies vaccine to the distribution warehouse based on the order request.
* Pharmacies and Hospitals – Submit vaccine orders from its clinics to the provider.
* Clinic: Maintains vaccine inventory

**System provides the following solution to the problem:**

* Vaccine Safety: The CDC is interested in learning as quickly as possible if a particular batch of vaccine is spoiled or making people sick. The problem could occur because of problems in manufacturing a particular set. The CDC wants to send a recall by tracing back the factory where that batch was made
* Reporting Vaccine Adverse Effect : The system should allow people to report any adverse effect of Vaccines to CDC , so that CDC can take appropriate steps based on the seriousness of the effect.
* CDC should have a view the number of vaccines available in the Vaccine inventory throughout the system at any point of time. To keep track of the number of vaccines distributed throughout the system.
* CDC should be able to notify the system regarding vaccine shortages.
* CDC should be able to track the vaccines causing adverse effect and contact the manufacturer to recall the vaccines that were sent in that particular LOT.

**Scope of the project:**

The project has been implemented at the national level, local level as in :

The vaccines can be distributed to the 50 different states in USA covering different regions within the state with the major entities such as CDC, PHD, Providers , Dsitributors, Manufacturer, Hospitals , pharmacies and their clinics allowing the distribution of vaccines at such a wide level to be possible.

The project can be replicated to include multiple networks (representing countries) and can be implemented to provide solutions based on global level, which would also fascillitate standardization of how vaccines gets distributed across the globe with the fascillities to tackle various problem that can hinder distribution of the vaccines in the timely manner and allow quick ways to handle vaccines adverse effect.

**Assumptions for the project:**

1. CDC manages the the department of public health which are responsible for approving the vaccines order request from the registered providers.
2. Providers receives vaccine order request from the registered Hospitals and Pharmaceuticals
3. Hospitals and Pharmaceuticals are responsible for forwarding the the vaccine order request for its Clinics .
4. Hospitals and Pharmaceutical Clinics are responsible for providing vaccines to the Patients .
5. Patients have 2 types of insurance status : Insured and Uninsured.

If a patient is insured the invoice goes to the Insurance company which is responsible for making the payment on behalf of the insured patients. If the patient is uninsured then the CDC will take care of the patients vaccine payments . CDC will receive the invoice directly from the clinics for the payment.

1. Clinics send vaccine order Request to its hospitals and phamaceuticals. They forward the order request to the providers with which they register. Each state has single provider which receives request from all the hospital and pharmacies within the state . Providers are registered with the state PHD and forward the request to their state PHD. PHD approves the order and the request is forwarded to CDC . CDC decides whether to approve of reject the order request based on the No. of vaccines the manufacturer has ready with it. CDC allocates Vaccines based on the percentage of population that state has (eg : if the total population is 100,000 and the state population is 5000, then the state is eligible for 5% of the vaccines available at the manufacturer).

After CDC approves, the request goes to the Distributor Warehouse (Distributor maintains Distributor Warehouses for each state) for that particular state. The Distributor Warehouse contacts the manufacturer for the shipment. Manufacturer send the shipment and the invoice to the Distributor Warehouse which send the shipment directly to the registered sites (Hospital and the Phamaceuticals). Hospitals and Pharmaceuticals send the shipment to their respective Clinics. The Distributor Warehouse sends the Invoice to the Provider . Provider sends it to the registered Hospitals and Pharmaceuticals . Provider receives the payment from the registered sites and makes the payment to the Distributor Warehouse which inturn makes the payment to the manufacturer.

**Use Cases : Roles and Responsibility**

**CDC:**

1. Responsible for approving/rejecting order from the PHD .
2. Report any vaccine shortage notification to all the entities in the system.
3. Receives Vaccine Adverse Event report from the all the entities and take required action based the seriousness of the adverse effect.
4. Keep track of the vaccines available thoughout the system.

**PHD:**

1. Responsible for receiving order request from the registered providers .
2. Can report any adverse event to the CDC.

**Providers:**

1. Providers receive order request from the registered sites and forward it to PHD.
2. Responsible for making payment to the Distributor Warehouse after collecting it from its registered sites.
3. Can report any adverse event to CDC.

**Hospitals and Phamaceuticals:**

1. Responsible for taking order request from its Clinics .
2. Make payments for the order request.
3. Can report any adverse event to the CDC.

**Clinics:**

1. Send order request its Hospitals and Phamaceuticals.
2. Provide Vaccines to the patients.
3. Maitains vaccine catalog
4. Send invoice and receive payments from the CDC and Insurance based on whether the person is inured or not.
5. Can report any adverse event to CDC.

**Manufacturer:**

1. Maintins Vaccine inventory.
2. Ships orders to the Distributor Warehouses.
3. Receives payment from the Distributor Warehouse.
4. Receives adverse event notifications from CDC and recalls the LOT of vaccines if needed.

**Distributor Warehouse:**

1. Receives Shipment from the manufacturer and sends it to the

Sites directly.

1. Sends invoice to the providers.
2. Receives manufacturer.

**Insurance:**

1. Receives invoice from the Clinics on behalf of the insured patients.
2. Makes payments to the Clinics.