## Cold Chain Equipment Inventory Data Model

Version 1.0, May 25, 2013

Version 1.2, June 5, 2013

Version 1.3, July 9, 2013

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## Proposed data model

Here is a basic data model, structured around facilities (which can be either health facilities or vaccine storage facilities), with equipment associated with specific health facilities. The model includes both Cold Chain Equipment Inventory as well as addition information that would be used across applications

* Health/ Vaccine storage facilities – information on each of the country’s health and vaccine storage facilities. The basic model for the inventory is to associate assets with facilities
* Core Assets – cold rooms, refrigerator/freezers, coldboxes and vaccine carriers.
* Asset catalogs – information associated with particular models of assets. (The issue of non-cataloged assets needs to be addressed).
* Country administrative hierarchy.
* Country name table.
* Facility equipment lists.

## Facility data model

Required indicates if this is essential for the inventory. Other fields could be made required by specific tools or deployments.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | Facility ID | String | Primary key for the application. This ID must be unique. | Y |
| 2. | National Facility ID[[1]](#endnote-1) | String | Official ID of the facility, from a master facility list. | N |
| 3. | Facility Name | String (UTF-8) | The name of the facility. Standard capitalization should be used. The UTF-8 representation allows multiple scripts to be used. | Y |
| 4. | ASCII Name[[2]](#endnote-2) | String (ASCII) | The name of the facility in ASCII (e.g., basic Latin characters, without accents). | N |
| 5. | Administrative Region[[3]](#endnote-3) | Admin NodeID | Location in the administrative (geographic) hierarchy. The information is extracted from the Admin Table | Y |
| 6. | GIS Coordinates[[4]](#endnote-4) | String | Use the ISO 6709 standard for representing latitude and longitude (and possibly altitude). Decimal degrees is the preferred format. | N |
| 7. | Facility Type[[5]](#endnote-5) | Enumeration | Type of facility from a fixed list of possibilities: StorageX, HospitalX, HealthCenterX, HealthPostX, OtherX. X is an integer that allows different levels of the same type. [List TBD] | Y |
| 8. | Facility Ownership | Enumeration | Ownership of facility from a fixed list of possibilities: Public, Private, NGO, FaithBased, Other. [List TBD] | Y |
| 9. | Facility Population[[6]](#endnote-6) | Numeric | Total catchment population for the facility. | Y |
| 10. | Facility Coverage[[7]](#endnote-7) | Numeric (Percent) | Percentage of Population receiving routine immunization services from the facility | Y |
| 11. | Storage Type | Enumeration | Storage for transfer to another facility, or storage for use at the facility. {Depot, Delivery, DepotAndDelivery, NoStorage} | Y |
| 12. | Vaccine delivery type[[8]](#endnote-8) | Enumeration | Static, Outreach, StaticAndOutreach, None | Y |
| 13. | Power Infrastructure | Composite | See below | Y |
| 14. | Cold Chain Logistics | Composite | See below | N |
| 15. | Contact Information[[9]](#endnote-9) | String | Phone number and contact official | N |

## Power Infrastructure

Four power sources are generally considered for the cold chain: electricity, kerosene, gas, and solar. Countries may restrict their number of power types, so NotApplicable should be an option (even if not available at the user level)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | Electricity Source[[10]](#endnote-10) | Enumeration | Grid, Generator, GridAndGenerator, None | Y |
| 2. | Grid Power Availability[[11]](#endnote-11) | Enumeration | MoreThan16, 8To16, 4To8, LessThan4, None | Y |
| 3. | Gas Availability[[12]](#endnote-12) | Enumeration | Available, Irregular, NotAvailable, Unknown, NotApplicable | Y |
| 4. | Kerosene Availability | Enumeration | Available, Irregular, NotAvailable, Unknown, NotApplicable | Y |
| 5. | Climate suitable for solar[[13]](#endnote-13) | Enumeration | Yes if area gets a sufficient number of hours of sunshine throughout year  Yes, No, Unknown, NotApplicable | N |
| 6. | Site suitable for solar | Enumeration | Yes if there are possible unshaded locations for solar panels  Yes, No, Unknown, NotApplicable | N |
| 7. | Climate zone | Enumeration | WHO zones: Hot, Moderate, Temperate | N |

## Cold Chain Logistics

Cold chain logistics information is technically not part of the equipment inventory, so it has been put into a separate component.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | Vaccine Supply Interval[[14]](#endnote-14) | Numeric | Interval of delivery or collection (in weeks). This is needed if it overrides national policy | N |
| 2. | Vaccine Reserve Stock Requirement | Numeric | Required reserve stock (in weeks). This is needed if it overrides national policy | N |
| 3. | Mode of Vaccine Supply | Enumeration | Delivered, Collected, DeliveredAndCollected, None | N |
| 4. | Distance to supply point | Numeric | One way distance in KM to closest supply point. | N |
| 5. | MainSupplyPoint[[15]](#endnote-15) | String | FacilityId of main supply point | N |
| 6. | SecondarySupplyPoint | String | FacilityId of secondary supply point | N |

## Storage Assets

### Refrigerator/Freezers

Refrigerators and Freezers are the most important asset for the inventory. There should also be a distinction between vaccine and icepack freezers. Since most of the equipment in use is from the PQS/PIS list, the way to handle asset information is to only store the model number, and then use a secondary table to represent the catalog information. We will assume that the catalog is augmented to include additional models. Generic entries can cover unidentified types of domestic refrigerators.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | Unique ID[[16]](#endnote-16) | String | Unique ID for the application. (This ID should be unique across all asset types) | Y |
| 2. | Model ID | String | Key into an official catalog. Information about the model is derived from this. | Y |
| 3. | Equipment tracking ID | String | Ideally, the real serial number. However, this is not always available or maintained at the facility. | N |
| 4. | Bar Code | String | If a barcode is used, the information can be stored here | N |
| 5. | Year[[17]](#endnote-17) | Numeric | Year of acquisition (manufacture). Often not accurate (but may not need to be.) | N |
| 6. | Source | String | Where the equipment came from | N |
| 7. | Working status | Enumeration | Functioning, AwaitingRepair, Unservicable | Y |
| 8. | Reason not working or not in use[[18]](#endnote-18) | Enumeration | NeedsSpareParts, NoFinance, NoFuel, Surplus, Dead, NotApplicable | N |
| 9. | Utilization | Enumeration | InUse, NotInUse, InStoreForAllocation | Y |
| 10. | Voltage regulator | Enumeration | For electric equipment, is it connected to a voltage regulator. Yes, No, Unknown, or NotApplicable. NA for non-electric | N |
| 11. | Power source[[19]](#endnote-19) | Enumeration | Electricity, Gas, Kerosene, Solar, Unknown | N |

### Coldrooms

This is a first cut on the cold room data.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | Unique ID[[20]](#endnote-20) | String | Unique ID for the application. (This ID should be unique across all asset types) | Y |
| 2. | Identifier | String | Model and type | Y |
| 3. | Manufacturer | String | Name of manufacturer | N |
| 4. | Storage Temperature | Enumeration | {Plus4, Minus20} | Y |
| 5. | Equipment tracking ID | String | Ideally, the real serial number. However, this is not always available or maintained at the facility. | N |
| 6. | Bar Code | String | If a barcode is used, the information can be stored here | N |
| 7. | Year[[21]](#endnote-21) | Numeric | Year of installation | Y |
| 8. | Source | String | Where the equipment came from | N |
| 9. | Working status | Enumeration | Functioning, AwaitingRepair, Unservicable | Y |
| 10. | Reason not working or not in use[[22]](#endnote-22) | Enumeration | NeedsSpareParts, NoFinance, NoFuel, Surplus, Dead, NotApplicable | N |
| 11. | Utilization | Enumeration | InUse, NotInUse, InStoreForAllocation | Y |
| 12. | Backup Generator | Enumeration | Yes, No, Unknown, or NotApplicable. | Y |
| 13. | Voltage regulator | Enumeration | For electric equipment, is it connected to a voltage regulator. Yes, No, Unknown, or NotApplicable. NA for non-electric | Y |
| 14. | Gross Volume | Numeric | Volume in m3 | N |
| 15. | Net Volume | Numeric | Volume in m3 | Y |
| 16. | Dimensions | Numeric triple | (Width, Depth, Height) in meters | N |

## Refrigerator Catalog

This information is associated with the PIS/PQS catalog. We don’t need all of the information from the PQS/PIS sheets. (Is there additional information that is of interest?) This will be augmented to handle other equipment types

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | Catalog ID[[23]](#endnote-23) | String | Primary Key from PQS/PIS | Y |
| 2. | Model Name | String |  | Y |
| 3. | Manufacturer Name | String |  | Y |
| 4. | Power source[[24]](#endnote-24) | Enumeration | Electric, Gas, GasElectic, Kerosene, KeroseneElectric, Solar, PassiveCooler | Y |
| 5. | Equipment Type | Enumeration | A simplified version from PQS without the power source: ChestFreezer, IcePackFreezer, ChestRefrigerator, IceLinedRefrigerator, UprightRefrigerator, SolarPhotvoltaicRefrigerator, SolarThermalRefrigerator | Y |
| 6. | Climate Zone | Enumeration | PQS Designation: Hot, Moderate, Temperate | Y |
| 7. | Data Source | Enumeration | PQS, PIS, Custom, Generic |  |
| 8. | Storage volume[[25]](#endnote-25):  GrossPlus4, NetLus4, GrossMinus20, NetMinus20 | Numeric | Can we just do Net volume. Although I would prefer just to report a single number, we probably need to give both +4 and -20 numbers | Y |

## Other Assets

The cold room format needs to be completed. The inventory also includes other asset types – there are vaccine carriers, which are often counted. These should be included in the inventory – although likely viewed as “supplies” – we are only interested in how many there are – not information on each individual carrier.

Transportation assets should be defined. These would be an optional component.

## Facility Equipment Lists

The link between equipment and facilities is no longer represented as part of the asset. In most cases, an asset can be associated with a facility, is it was convenient to represent the information by just recording a facility with an asset. However, there are a few exceptions to this, and logically, the facility is not a property of the asset.

For completeness, we specify a simple scheme of asset, facility pairs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | FacilityID | String |  | Y |
| 2. | EquipmentID | String |  | Y |
| 3. | AssetType | Enumeration | Refrigerator, ColdRoom, etc | Y |

## Administrative Hierarchy

The administrative hierarchy is represented as a collection of nodes. Each node in the hierarchy has a unique ID, so that facilities can be assigned to an arbitrary position in the hierarchy.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | NodeID | Integer | Unique non-negative integer ID | Y |
| 2. | Name | String | UTF | Y |
| 3. | Ascii Name | String | Ascii | N |
| 4. | Level[[26]](#endnote-26) | Integer | National level (root) is level 1 | Y |
| 5. | Parent | Integer | Node ID of Parent. (-1 for root) | Y |
| 6. | Category[[27]](#endnote-27) | String | UTF – Subdivision category | Y |
| 7. | AsciiCategory | String |  | N |
| 8. | ISOCode | String | Code from ISO 3166 | N |

## Country Name Table

For compatibility across countries, some information is represented generically (names of administrative levels, health facility types). To enable applications to appropriately display this information, a table of names in presented. Names are represented in both UTF-8 and Ascii. Information will be recorded for Adminstrative Levels, Facility Ownership, Facility Types. The level is given for each type to allow an arbitrary number of levels.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Name | Type | Comments | Req. |
| 1. | GenericName | Enumeration | AdminLevel, VaccineStore, Hospital, HealthCenter, HealthPost, OtherHealthFacility, Public, Private, NGO, FaithBased, OtherOwner | Y |
| 2. | Level | Integer | Starting from 1 | Y |
| 3. | Name | String | UTF-8 | Y |
| 4. | AsciiName | String | Ascii | Y |

1. In the ideal case, we would be able to use the National ID as the facility key. However, even when a national facility ID is available, there are likely to be cases where an application diverges from the national ID, so we must keep them separate. [↑](#endnote-ref-1)
2. The ASCII representation is included to facilitate applications which use multiple country data sets. The ASCII representation is also useful for compatibility with other software tools and making it easier to search the data. [↑](#endnote-ref-2)
3. The administrative region is the geographic region that the facility is associated with, which might not be the lowest level in the administrative hierarchy. There are some data sets where the lower levels of the administrative hierarchy are not indicated, which requires associating the facility with a higher level. One issue that is not addressed here is that the health administrative hierarchy might be different from the political administrative hierarchy. [↑](#endnote-ref-3)
4. Multiple formats are used for GIS coordinates. Standardizing on latitude and longitude is a significant simplification. The string representation increases flexibility. [↑](#endnote-ref-4)
5. Standardizing facility types might be controversial. The actual types are still to be determined. Vaccine storage facilities are one obvious type. The proposal that Hospitals, Health Centers, and Health Posts are the other main types. Possibly there are additional ones, and there would be Other for types that were missed. Giving numbers with types allows different levels to be represented. These names will be internal codes for the application. A table can convert them to the country specific name. [↑](#endnote-ref-5)
6. The total population is used, instead of breaking this down to groups such as newborns or pregnant women. These can generally be derived through country specific multipliers. [↑](#endnote-ref-6)
7. The population that receives immunization services from the facility. Some facilities (such as hospitals) may have a large catchment, but few people get their immunization from the facility. I am assuming this is still in terms of the total population (and does not just count under ones.) [↑](#endnote-ref-7)
8. As a minor detail – these could be represented as separate booleans. [↑](#endnote-ref-8)
9. Experience shows that this is a very useful field. To allow flexibility, it will be kept as a string. [↑](#endnote-ref-9)
10. This is referring to the electricity source for vaccine storage – so the generator would be providing power to the vaccine storage equipment. [↑](#endnote-ref-10)
11. The idea is to provide four buckets: GreatThan16 – Regular electricity. 8To16 – Outages occur, so that an ILR is required for adequate hold over. LessThan8 – Long outages, so alternate fuel devices or backup power for an ILR is needed. None – no grid power. It is very difficult to collect more specific information about electricity availability, especially since it is often highly variable throughout the year. [↑](#endnote-ref-11)
12. Gas and Kerosene have the same enumeration type. The Irregular label captures multiple possible problems (irregular supply or poor quality). NotApplicable is available as a type to cover cases where gas or kerosene is not a relevant fuel source. [↑](#endnote-ref-12)
13. Evaluating solar is controversial. The approach here is to record to values – the first is whether the climate is suitable for solar – so this depends on latitude, longitude, and rainfall patterns. This does not require a site visit to determine this. The other variable is whether or not there is an unshaded location so that panels could be installed, which requires some knowledge of the site. Sites would require both values to be yes in order to be suitable for solar. [↑](#endnote-ref-13)
14. Supply intervals if they differ from national guidelines for the facility type. Interval in weeks. Monthly is 4 weeks, Quarterly is 13 weeks. [↑](#endnote-ref-14)
15. The standard becomes simpler if we have just a fixed number of options – so I have just included two. [↑](#endnote-ref-15)
16. Key for equipment used by the application. This must be a unique identifier. This can be used in the table the links equipment to facilities. [↑](#endnote-ref-16)
17. A convention needs to be determined to represent Unknown Age. 1900, 0, -1 or null are all possibilities. I lean towards 0 – as it is less likely to cause problems for applications. [↑](#endnote-ref-17)
18. This is useful, but will not be easy to get. If it use, NotApplicable should be selected [↑](#endnote-ref-18)
19. This is important information for machines which can have multiple power sources (EG or EK equipment). It is not of interest for equipment that has only a single option for power. [↑](#endnote-ref-19)
20. Key for equipment used by the application. This must be a unique identifier. This can be used in the table the links equipment to facilities. [↑](#endnote-ref-20)
21. A convention needs to be determined to represent Unknown Age. 1900, 0, -1 or null are all possibilities. I lean towards 0 – as it is less likely to cause problems for applications. [↑](#endnote-ref-21)
22. This is useful, but will not be easy to get. If it use, NotApplicable should be selected [↑](#endnote-ref-22)
23. A convention needs to be developed for catalog IDs for non PQS/PIS equipment [↑](#endnote-ref-23)
24. Long term passive cooling could also be included to capture devices being developed by Sasnu and IVL. [↑](#endnote-ref-24)
25. All four values are included [↑](#endnote-ref-25)
26. The hierarchy is represented as level, with the national level at level one. The assumption is that each node points to its parent in the tree, which is one level lower. [↑](#endnote-ref-26)
27. There can be multiple subdivision categories at the same level of the hierarchy, e.g, state, federal district, and outlying territory [↑](#endnote-ref-27)