RHINoVision

A Decision Support System with Interactive Multivariate Visualizations

RHINoVision is both an innovative concept for visualization of routine health information and a software application that builds on the methodology outlined in the MEASURE Evaluation “Building a Web-Based Decision Support System” working paper. The RHINoVision open source Decision Support System presents two graphs in tandem that play to the strengths of routine health information system (RHIS) data, in that they empower users with simultaneous visualization of data over time and geography. RHINoVision features powerful multivariate visualizations for triangulation of data from different programs and data sources and for “drill down functionality” that empowers users to visualize patterns in the underlying data.


A demonstration of the RHINoVision functionality, using national tuberculosis data for 23 USAID Priority Countries (data source: https://www.who.int/tb/country/data/download/en/) can be found in the TB Decision Support System. TB stakeholders in national governments, ministries of health, and national TB programs can use it to make informed decisions on USAID TB interventions.

What is it and why is it called RHINoVision?

The Routine Health Information Network (RHINo), was created in 2001 to connect individuals and organizations working to strengthen routine health information systems, provides information, tools, and technical resources to address the challenge of improving routine health information systems throughout the developing world.
The Rhino is the spirit animal of the RHINo Network. But Rhinos don't see very well. So the birds gather on their backs and the Rhinos use the birds to help see. That's RHINoVision.

Not only do the birds help the Rhinos monitor and evaluate their situation, the birds can examine the underlying data to improve the quality of the Rhino's skin by keeping them clean and bug-free. The birds also fly around and have a “birds-eye-view” of everything around, helping Rhinos triangulate data across various routine and non-routine sources, thus helping to verify that their data is valid and credible.

RHINoVision adapts the principles of Biomimicry to empower users of routine health information.

Presenting and sharing data in usable formats is a critical dimension of a strong, well-functioning RHIS. That is RHINoVision, an innovative concept of visualizing data. RHINoVision multivariate visualizations show simultaneously "what happened" (time trend graphs) and "what's happening around you" (regional comparison graphs, scatterplots, bubble graphs). RHINoVision allows users to drill-down and examine patterns in the underlying data and compare across regions using powerful interactive features.

RHINoVision Development

RHINoVision development used what Epidemiologists call “the stubby pencil approach” and what Biostatisticians call “programming by brute force”. RHINoVision uses freely available, open source solutions, and basic programming tools. No proprietary code-generators or system building applications were used. PHP code was written using a basic Text Editor (Notepad ++). Data is stored in a MySQL database, on a commercial server, with no special installation procedures needed. ADOdb, a database abstraction layer for PHP, was used to access the MySQL data. RHINoVision links to the Highcharts library, for interactive graphics functionality. These graphs feature interactive mouse-hover data display, zoom, and rotation for the 3D scatterplots.

The “heart” of RHINoVision is the electronic data dictionary in the database engine. The data dictionary contains all the information about the data – sources, indicators, field names, table names and the relational codes and parameters needed to find and present data. The data dictionary also stores information that RHINoVision uses when generating Dashboards.

The Dashboards use fields in the data dictionary to determine what indicators appear on the dashboard. The RHINoVision dashboards can also display any special visualizations that have been prepared, and users can choose indicators for further analysis. At the top of the first dashboard, the aggregate dashboard, are drop-down boxes that users can use to choose subsequent dashboards, for selecting indicators in specific focus area or country.

As the data dictionary is the heart of RHINoVision, the Master Facility List (MFL) is the backbone for the interoperability of various data systems. The MFL contains geographic coordinates for all health facilities in a country, as well as the codes, references, location information (such as
region, district, and ward data) needed to create organizational unit hierarchies. An MFL facilitates the planning, management, and targeting of services, through mapping and visualization of the distribution of health services and resources. When housed in a Decision Support System, its value and potential uses increase substantially. **RHINoVision** follows the guidance for visualization of MFL data found in the [MFL Resource Package: Guidance for countries wanting to strengthen their MFL](#).

### RHINoVision Functionality

To demonstrate the functionality of **RHINoVision**, we choose three related variables, female Pediatric TB Cases, Total Pediatric TB Cases and Male Pediatric TB Cases. We would expect that the males and females would each be around 50%, and the total Pediatric cases would be about twice as much as either gender.

From the Aggregate Focus Area dashboard, and the Country Focus Area dashboard, users select an indicator from the drop-down list, and the **RHINoVision** dual image screen appears, with various options available. For instance, the user can choose different line and bar graph options.
Users can drill down to examine the underlying data. For instance, from the aggregate time trend, the user can choose “All Priority Countries” from the drop-down list. The graph updates with lines for all countries.

The user selects a second variable (x variable) for bivariate analysis. **RHINoVision** adds the second variable on the line graph and as the x-variable on the x-y scatterplot. The first variable is placed on the y-axis (dependent variable).

The user can select whether the two variables have different y-axes, or use the same y-axis.
The second variable added as a denominator (rate or ratio). At the country level, the user can choose to visualize just the data for their region as well.

The user selects a third variable (z variable) for multivariate analysis. **RHINoVision** adds the third variable on the line graph and as the z-variable (size of the bubble) on bubble graph and on the x-y-z scatterplot. The first variable remains on the y-axis (dependent variable).

For the geographic comparisons, **RHINoVision** displays an x-y scatterplot of the two bivariates and a bubble graph where the z variable is the size of the bubble in the scatterplot for three variables. The user can also select a rotatable 3-D scatterplot for graphs with three variables.
Users can also visualize chosen indicators on a Thematic Map. The map is loaded into a separate browser tab.

**Example RHINoVision Thematic Map**

**RHINoVision Use for Informed Decisions**

The examples show national data, but imagine the power of RHINoVision in the hands of the District Health Officer. Just as the birds find ticks and bugs in the RHINO’s skin, RHINoVision empowers that District Officer to drill down and compare health facility data. In addition, just as the birds look up and around, RHINoVision empowers that District Health Officer to compare his status and progress with other Districts.

Next, imagine if our District Health Officer has his decision support system with RHINoVision linked to the Routine and non-Routine Data Sources that are available. Just like the birds on the RHINO that can fly around and have a “Birds-eye-view” of everything around, the District Health Officer can triangulate across both routine and non-routine data sources, thus helping to verify that his data is valid and credible.

Finally, imagine there is natural disaster or disease outbreak, a RHINoVISION enabled MFL helps responders know where health facilities are located and what services are available. When Haiti was struck by an earthquake, there was an urgent need to know where health facilities were located. The National Haiti Information System (système HSIS) was the main source of both health and geographic data, and was used by international disaster responders in the recovery effort.
Most data on the provision of clinical services or health status at the time of clinical encounters are generated “routinely” during the recording and reporting of services delivered.

The population census is the primary information source for determining the size of a population and its geographical distribution. In many developing countries, population surveys are the single most important source of population health information. Of the 23 health-related MDG indicators, 17 are currently generated through household surveys, such as the USAID-supported Demographic and Health Surveys (DHS).

Health facility surveys provide another important methodology for collecting data on health services and for validating routine health service data by observing service delivery, inspecting facilities, interviewing staff and clients, and reviewing archives.
In trigonometry and geometry, triangulation is the process of determining a single point in space with the convergence of measurements taken from two other distinct points.

Organizations have lots of data that is often untouched in organizational and software "silos." Triangulation means connecting these silos.

Analysis of data from multiple sources can increase the validity and reliability of findings. It can corroborate findings and weakness of any one data source can be compensated for by the strengths of another.

Analysis of program level data with outcome/impact level data can help substantiate the linkage between program interventions and population-level outcomes/impacts.
Now, imagine you are working in a country as a Program Manager, Monitoring and Evaluation Officer, with a donor organizations, or, just someone from the community that wants information. There is a “Health Observatory” – with RHINoVision, that has links to both routine and non-routine data sources. You can triangulate anything with anything, drill down and look up into the data and make comparisons that help you make evidence-based programming, resource allocation, and policy-making decisions. RHINoVision empowers the use of information for evidence based decision making at all levels. The ultimate goal of any health information system is to produce information that can improve the functionality of the health system. You are able to link to data and examine relationships in ways that were previously unimaginable. That’s RHINoVision.

Two stereotypes have persisted through the years, and RHINoVision addresses them both. First is the stereotypical way of saying: “routine HIS produce low quality data that are not used, so let us do population or facility surveys”. RHINoVision can be used to support data cleaning to improve data quality, and can link to the population and facility surveys as well. These data sources are complementary, and can only be fully exploited when linked to the RHIS. Second, is the frustration that “Isn’t there some secondary analyses we can do with the DHS, so that it isn’t just a final report sitting on the shelf?”. RHINoVision can link to any countries’ DHS data using the DHS Program Application Programming Interface (API). Just as the DHS Final Reports present indicators in tables with disaggregates by Birth Order, Age, Region, Education, Residence (Urban/Rural) and Wealth Quintile, RHINoVision visualizes those disaggregates over time, linking the existing DHS Surveys.

Using DHIS Program APIs, RHINoVision pulls data from the Statcompiler database.
What about **DHIS 2**?

First of all, **RHINoVision** has a library of [DHIS 2 API](#) functions that can access DHIS 2 and the DHIS 2 hierarchy. Secondly, why not DHIS 2! **RHINoVision** is a concept and methodology that can be set up using DHIS 2 or any other application development toolkit. DHIS 2 developers can of course adapt **RHINoVision** methodology in their DHIS 2 apps and dashboards. **RHINoVision** completely meets the standards outlined in the “Tools for Data Analysis” in MEASURE Evaluation’s [Guidelines for Data Management Standards in Routine Health Information Systems](#). Systems built with any toolkit should strive to meet those standards.

In summary, **RHINoVision** is a powerful analytic and visualization tool and this type of visualization is of interest to anyone who uses routine health data, and/or who wants to triangulate with data from multiple sources. In particular, this type of analysis is of interest to countries working toward building Health Observatories, which provide interactive access to large and diverse data sets. This type of visualization is also useful for the analyses needed to show the relationship between measurements of a country’s capacity and a country’s commitment in USAID’s “**Journey to Self-Reliance**” strategy.

For further information, contact:
Michael Edwards, PhD, MPH  
Biostatistician  
**RHINoVision** Decision Support Systems  
medwards44@gmail.com