

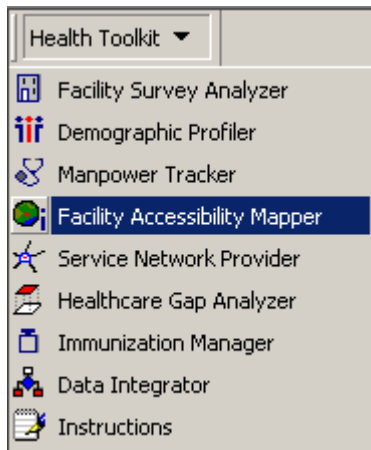


Overview: Health GIS Toolkit Version 1.0

The USAID/Yemen **Health GIS Toolkit** is an ESRI ArcGIS™ extension that allows you to analyze health information and influential factors and visualize results using map outputs. Version 1.0 of the **Health GIS Toolkit** contains eight applications designed to support evidence-based approaches for facilitating informed health planning, management, and policy decisions. The tools are comprised of customized Visual Basic computer code running directly within the ESRI ArcView 9.x GIS environment.

Once the CD-ROM is inserted, the setup file will run automatically (if not, browse files accessible on your CD-ROM drive and double click the "setup.exe" file). The program will install the Yemen GIS base map data layers and results from the 2004/2005 Yemen Ministry of Public Health and Population (MoPHP) Health Facility Survey into a newly created folder, C:\YemenHealth GIS. At this time, only survey results for the governorates of Amran, Al Jawf, Marib, Sa'adah, and Shabwah are available.

The program will launch ArcMap using a customized .mxt file containing the **Health GIS Toolkit** and a partial set of pre-loaded data layers. The **Health GIS Toolkit** appears as a drop down menu from the ArcMap toolbar in the ArcGIS ArcMap interface:



The next column contains a brief description of each tool. Detailed instructions for use of each tool follow on pages 2 – 9. These instructions are also accessible electronically by clicking on *Instructions* in the Health Toolkit lookup table.

Facility Survey Analyzer: Interfaces directly with the comprehensive 2004/2005 Yemen Ministry of Public Health and Population (MoPHP) health facility survey database. Queries, analyses, and comparisons are supported by health facility type, survey data categories, and geographic extent.

Demographic Profiler: Generates density maps based on key demographics available from the 2004 Yemeni Census. Data can be aggregated to any geographic level selected.

Manpower Tracker: Profiles health occupations using pie charts and bar graphs based on user-defined skill sets of the health cadre across Districts or Governorates.

Facility Accessibility Mapper: Calculates and displays the area surrounding a health facility that meets a user-defined time-travel accessibility criteria. The spatially-enhanced accessibility algorithm accounts for variable walking speed, distance, and topography (elevation and slope dynamics).

Service Network Provider: Illustrates health care service networks using the area around a facility that is closer to that facility than any other selected facility. Populations can be summed across the regions.

Health Care Gap Analyzer: Identifies gaps in health care coverage based on comparison between the accessibility area and the service network area calculated in accordance with user-defined parameters.

Immunization Manager: Integrates monthly/quarterly reports from District immunization management information systems and generates time series mapping layers.

Data Integrator: Incorporates user data directly for datasets that lack a common identification (ID) field by matching the common name/text fields in both datasets and evaluates a most likely match. The tool automatically joins the user's data into the Health GIS.

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Health GIS Toolkit, Version 1.0, October 2, 2006



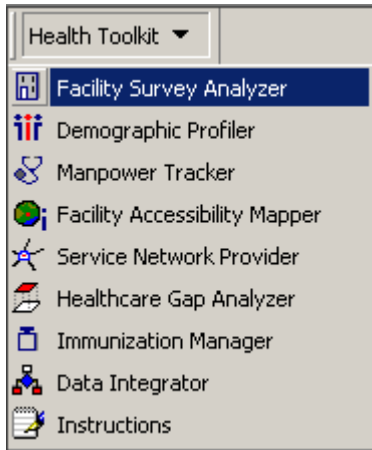


Health GIS Toolkit: Facility Survey Analyzer

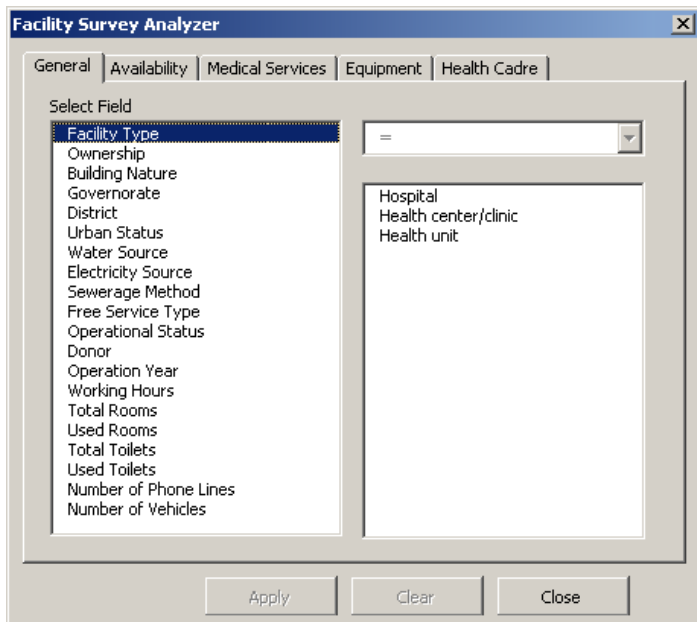
Purpose: The **Facility Survey Analyzer** provides a fast and easy way to locate a set of facilities that meet specific targeting criteria. Facilities in Amran, Al Jawf, Marib, Sa'adah and Shabwah (and other governorates in the future) can be queried for information from the 2005 Ministry of Public Health and Population (MoPHP) facility survey database.

Directions:

1 Select **Facility Survey Analyzer** from the Health Toolkit drop down menu.



2 The **Facility Survey Analyzer** has five tabs. You may select items from any or all of the tabs to create your own custom selection.



In the 'General' tab, select one field at a time from the left column, and enter your criteria on the right. Hold down the Control key to select multiple items from the list on the right. Depending on the field, you will be able to select from a pre-

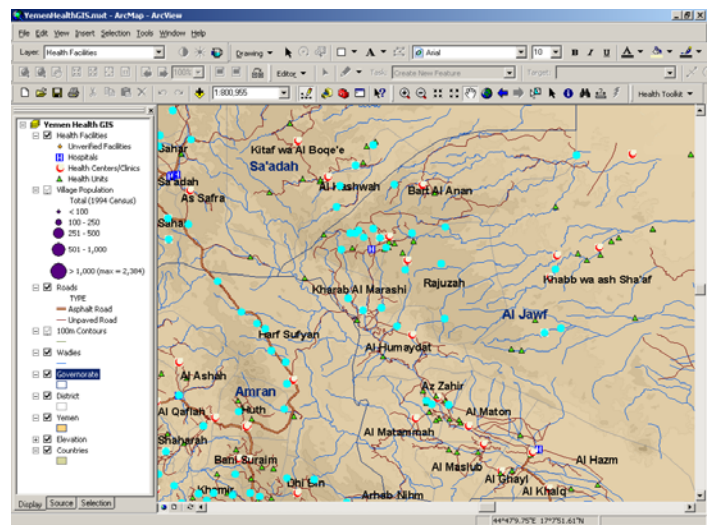
defined set of options or will be asked to type in a number of your choosing (e.g. 'Total rooms > 5').

In the 'Availability' and 'Equipment' tabs, you may limit your selection to facilities where specific items or services are 'available' or 'unavailable'.

The 'Medical Services' and 'Health Cadre' tabs allow you to check multiple services or occupations. This will locate only facilities that have all of those services/staff members available.

If at any point you want to start over in your selection, click 'Clear' and all fields on all tabs will be cleared.

3 When you have finished selecting the combination of items that interest you, click 'Apply' and you will see a pop-up message that says how many facilities were selected by your query. Click 'Ok' to return to the map and the facilities that meet your criteria will be highlighted.



Uses: The **Facility Survey Analyzer** can be launched to target facilities, map their locations relative to population centers, and identify gaps in coverage based on user-defined criteria. Example analyses include locating facilities:

- with or without electricity
- providing normal delivery or family planning services
- with or without a midwife or other female provider
- unable to support a vaccine cold chain/immunizations
- with or without a clean water supply
- referring patients who need an X-ray
- providing inpatient care
- without adequate medicine available
- with or without a doctor on staff
- with working hours greater than a specified amount

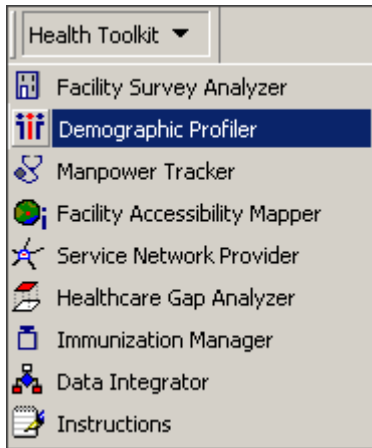
The **Facility Survey Analyzer** can also be used to create a subset of targeted facilities as inputs combined with other Health Toolkit applications, such as the *Facility Accessibility Mapper* and *Service Network Provider*.

Health GIS Toolkit: Demographic Profiler

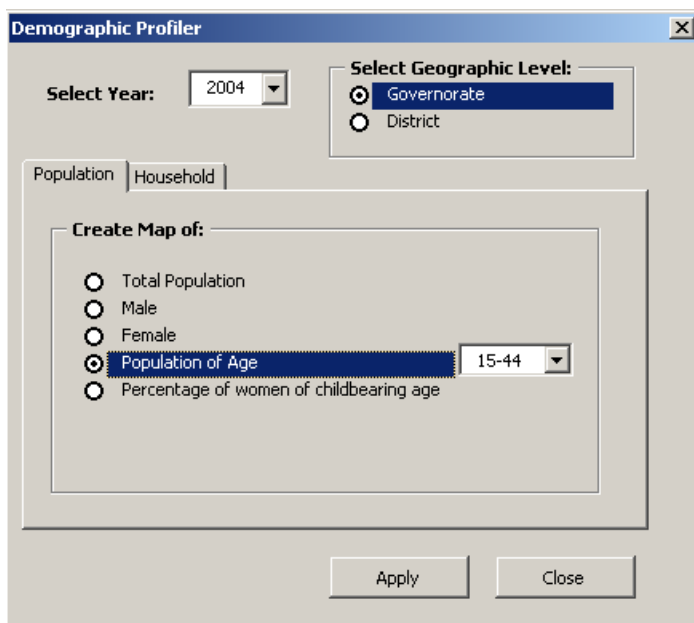
Purpose: The **Demographic Profiler** generates thematic maps and pie charts based on key demographics available from the 2004 Yemeni Census. Data can be aggregated to different geographic levels. Currently only 2004 census data in Amran, Al Jawf, Marib, Sa'adah and Shabwah are available.

Directions:

- 1 Select **Demographic Profiler** from the Health Toolkit drop down menu.



- 2 The **Demographic Profiler** has options for data year, geographic level, and map type. You may create your map at the governorate or district level.

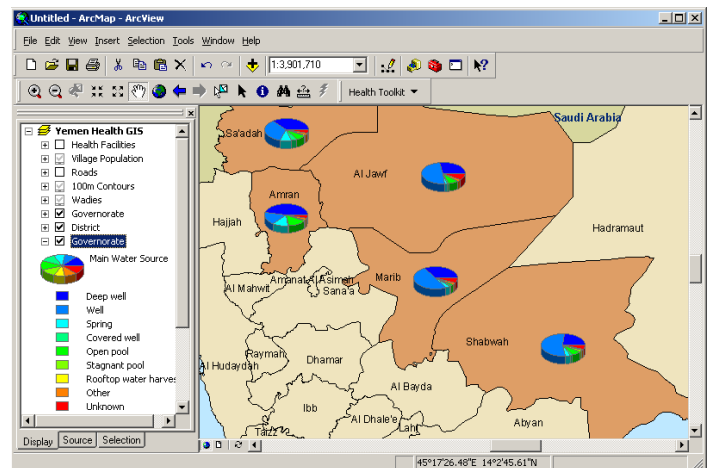
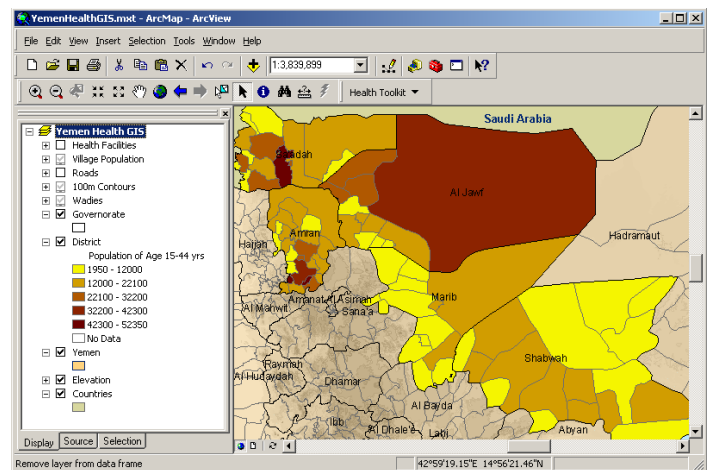


There are two tabs containing map type options. The 'Population' tab allows you to map census counts for the total population or specific sub-types. If you select the 'population of age' option, it will enable the drop down box, allowing you to

select a particular age range. Any map type option selected from the 'Population' tab will generate a thematic map.

The 'Household' tab contains options for housing type and utility sources. In each district or governorate, there are a variety of housing and utility types used by the local populations. For example, water sources may come from wells, springs, rooftop collection or pools. Selecting an option from this tab generates a pie chart summarizing the portion of each housing/utility type used in each geographic region.

- 3 You may choose one map type at a time. Click 'Apply' and the thematic map or pie chart will be generated.



Uses: The **Demographic Profiler** can be used for rapid assessment and targeting for demand and distribution of health care services. For example, results of this tool can be compared with the *Manpower Tracker* to ensure demand and supply of specific health care services equate. The **Demographic Profiler** can quickly display and visualize the information available from the Yemen census. As more census data become available, the tool will be expanded to utilize all available information.

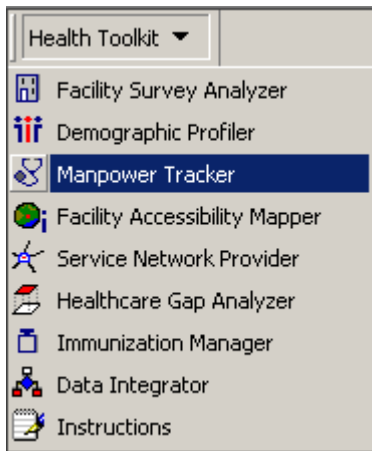


Health GIS Toolkit: Manpower Tracker

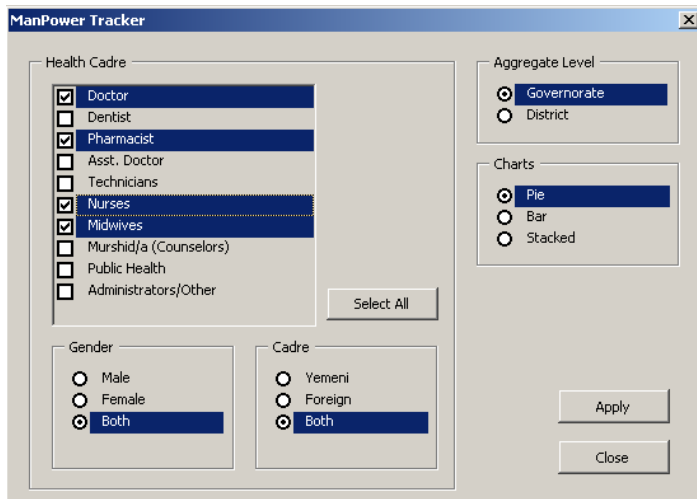
Purpose: The **Manpower Tracker** tracks the relative proportions of health care workers by occupation across geographical areas for targeting purposes. Results can be displayed as pie charts, bar charts or stacked bar charts. Occupation data is currently only available in Amran, Al Jawf, Marib, Sa'adah and Shabwah, based on information gathered in the 2005 Ministry of Public Health and Population (MoPHP) facility survey. Data for other governorates is forthcoming.

Directions:

1 Select **Manpower Tracker** from the Health Toolkit drop down menu.



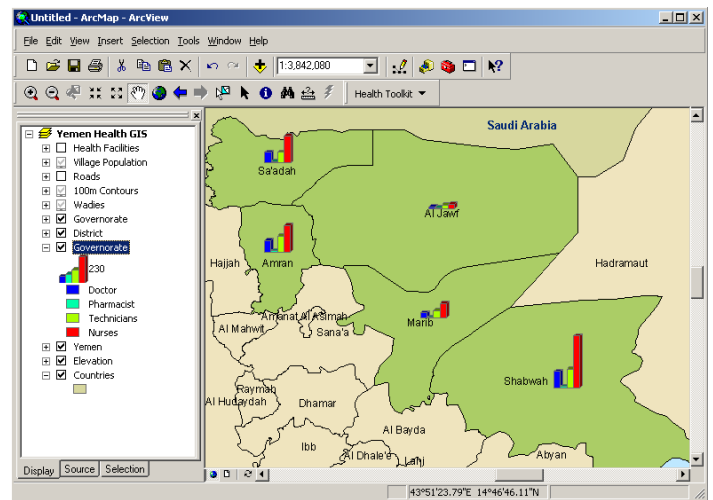
2 The 'Health Cadre' box provides a list of healthcare occupations. Select two or more occupations to include in your chart. The 'Gender' box allows you to limit your count to only male or only female staff for each occupation. In the 'Cadre' box, you can limit your selection to only Yemeni nationals or only foreign nationals. The default selection 'Both' in the two boxes means that all staff, regardless of gender or nationality, will be counted in your chart.



In the 'Aggregate Level' box, select the geographic level you would like to display. Facility-level occupation data can be aggregated to either the district or governorate level.

In the 'Charts' box, select the chart type: pie, bar or stacked. Pie charts will give you the relative proportions of each occupation type in the geographic area; bar charts and stacked bar charts will show both the relative proportions within a geographic area and the differences in staff size across geographic areas (i.e., the bar heights will vary). Bar charts will also display in the map document's table of contents the total staff count included in your selection across all geographic areas.

3 Click 'Apply' to generate a chart based on your selection. A map will be displayed showing either district or governorate boundaries with the pie or bar charts displayed on top of each region. The list of the different occupation types, by color, is displayed in the table of contents.



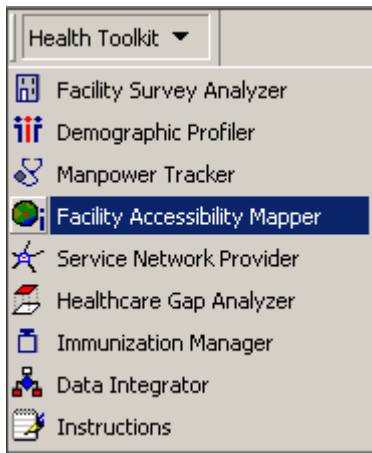
Uses: The **Manpower Tracker** can be used to target and analyze specific components of health care staffing resources, filtered by gender and nationality, to get an overall picture of health services available in each district or governorate. In turn, this information can be used to understand what regions lack adequate staffing or have a relative imbalance of occupation types. Focusing on female health cadre helps pinpoint areas where trained female staff is lacking. For example, the distribution of midwives, which can be an integral component of the rural health care provider network, can serve as an indicator of adequate reproductive health services. In general, the **Manpower Tracker** can inform health cadre deployment and reallocation decisions to improve health care equity and effectiveness performance, particularly in rural or remote areas. Maps produced from this tool can be used to visually highlight areas of concern for overall health care system management, planning, targeting, and reporting.

Health GIS Toolkit: Facility Accessibility Mapper

Purpose: The **Facility Accessibility Mapper** calculates the area surrounding a facility that can be reached within a user-defined time frame. This time-based approach takes into consideration variable walking speed, distance, and the topography of the area to develop an estimate of how far a person can actually travel in a designated amount of time. The **Facility Accessibility Mapper** provides a more accurate measure of accessibility in areas of highly variable terrain than the standard distance-based buffer tool can offer.

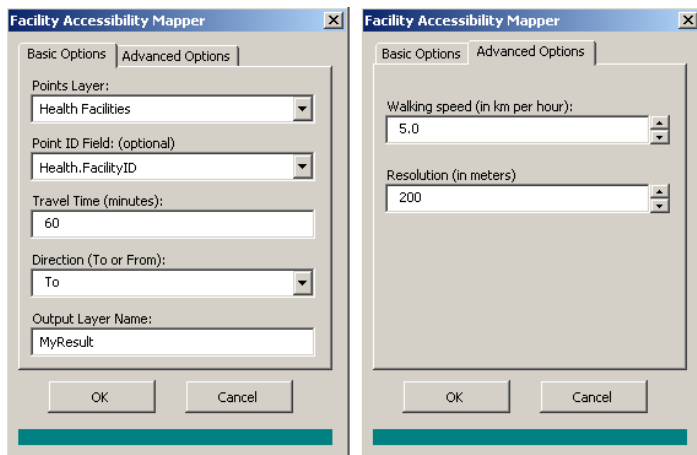
Directions:

- 1 Select **Facility Accessibility Mapper** from the Health Toolkit drop down menu.



- 2 Select the Health Facility layer as the input Points layer. If the Facility layer has a set of points selected, the **Facility Accessibility Mapper** will run only on that set of points. For a local level analysis, one facility can be selected.

Use the optional Point ID field to attach the Facility's ID field to the output file. This feature allows for linking each accessibility area to its original facility.



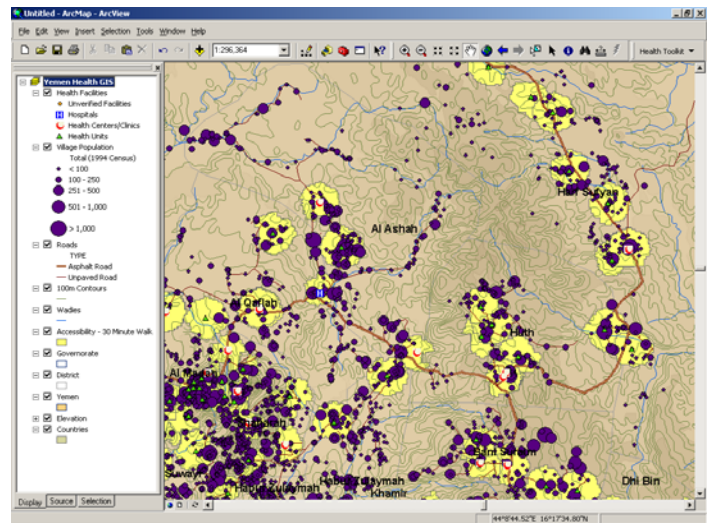
Assign a travel time based on how far a person is expected to be willing to walk to or from the facility. The accessibility areas generated in this tool are based on this time-travel distance. The direction can be set 'to the facility' or 'from the facility'. This feature takes into account the direction a person is headed, and adjusts walking speed to account for whether they are going uphill or downhill.

The Output layer is the name of the result file you are creating. You do not need to enter a file extension.

On the 'Advanced Options' tab, you can adjust the default walking speed. The walking speed is an estimate of how fast a person walks on a flat surface. The program then slows the walking speed relative to that pace as it encounters rising elevation.

Under 'Advanced Options', you can also adjust resolution. The program works with an underlying grid to calculate distance. The resolution is a measure of how small a grid is being used for the calculations. The default is a 200 m resolution; however you can adjust this resolution from 100 – 1000 m to refine your results.

- 3 Click 'Ok' to begin generating the accessibility regions. The file will be generated and added to the map document. It will also be saved in the C:\YemenHealthGIS\UserData folder for later retrieval.



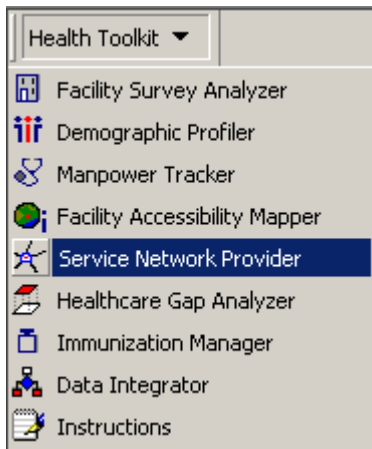
Uses: The **Facility Accessibility Mapper** can be used to accurately assess and visualize various levels of accessibility for populations directly served and to gauge potential gains in efficiency, equity, and effectiveness of health care interventions. Additionally, the **Facility Survey Analyzer** can pre-screen facilities of interest prior to running this tool to assess gaps and track performance based on accessibility under targeted scenarios. Note that the **Facility Accessibility Mapper** can be run not only on health facilities; it can be adapted for other points such as pharmacies, schools, potable water sources, voting centers, agricultural markets, commodity outlets, service centers, etc.

Health GIS Toolkit: Service Network Provider

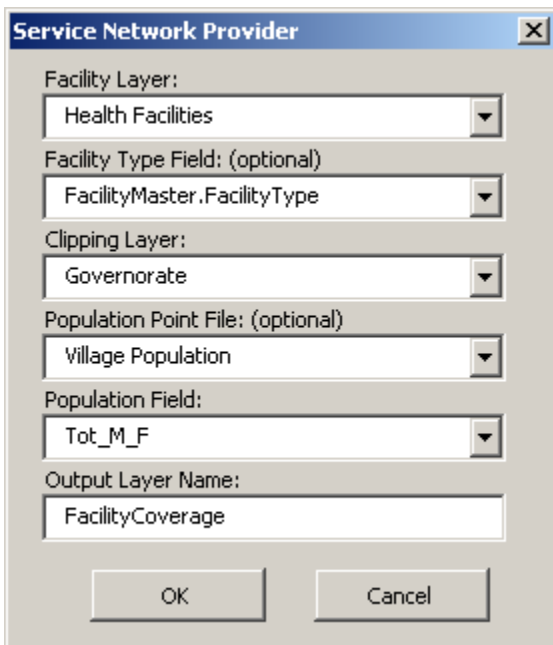
Purpose: The **Service Network Provider** generates polygons that define a 'region of influence' around a facility. The 'region of influence' is defined as the area around a facility that is closer to that facility than any other selected facility ('Thiessen polygons'). The tool can also sum up the number of other facilities and the total population that fall within this region. For a given facility, the **Service Network Provider** defines the populations and referral facilities that it is currently expected to serve.

Directions:

- 1 Select **Service Network Provider** from the Health Toolkit drop down menu.



- 2 Select the Health Facility layer. If the Facility layer has a set of points selected, the **Service Network Provider** will run only on that set of points.



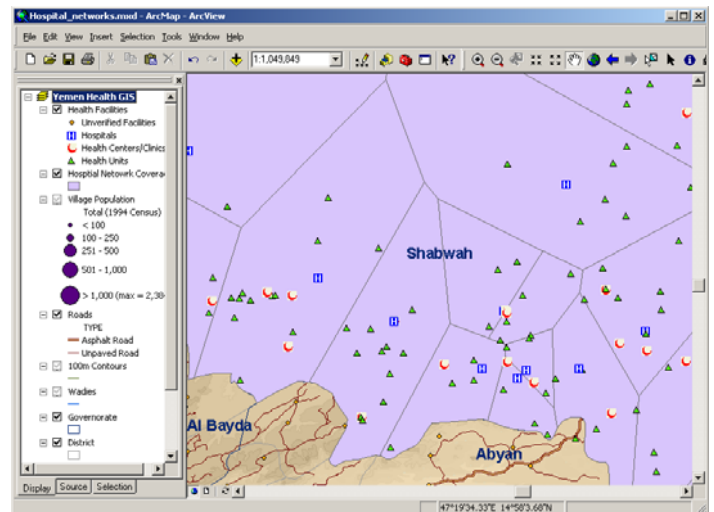
Optionally, you can select the 'Facility Type' field to summarize the number of hospitals, health centers and health units that fall

within the each selected facility's area. The count of each type will be summarized in a new column added to the dataset. Note that if you run this tool on the full set of facilities in your dataset, no other facilities will fall within each area. Leave this drop-down option blank if you do not wish to create a facility type summary.

The clipping layer sets the outer boundary of the polygons that are generated around each facility. Normally this would be the bounding districts, governorates or country. If a subset of the clipping layer is selected (e.g. a specific set of governorates), the tool will use only that subset in creating the boundary.

Optionally, you can add a point file, such as a Villages layer, that contains population data. Select the population field and the program will sum up the total population living with each selected facility's area. This population count will be summarized in a new column added to the dataset. Leave these drop-down options blank if you do not wish to create a population based summary.

- 3 Enter a name (with no file extension) for the output file and click 'Ok'. The Thiessen polygon file will be generated and added to the map document. It will also be saved in the C:\YemenHealth GIS\UserData folder for later retrieval. Open the associated attribute table to view the Facility Type and Population summary fields or use these fields as a basis for map classification (e.g. color the polygons by population size).



Uses: The **Service Network Provider** can rapidly profile facilities meeting specified criteria (e.g., hospitals, facilities with X-ray machines, or facilities with vaccine cold chains) to determine how large an area each facility is currently covering. In particular, it can be used to determine how many other facilities in the area rely on the services offered at the facility, and how large a population it is expected to serve. With this information, a better allocation of resources can be determined. The **Facility Survey Analyzer** can be used to pre-screen facilities of interest prior to running this tool. The results of the **Service Network Provider** can also be used as an input for the **Healthcare Gap Analyzer**. Note that this tool can be run not only on health facilities; it can be adapted for other points such as pharmacies, schools, voting centers, agricultural markets, commodity outlets, service centers, etc.

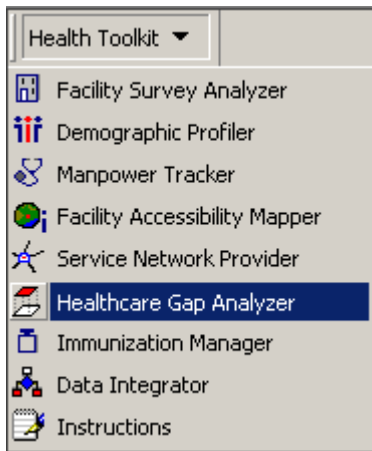


Health GIS Toolkit: Healthcare Gap Analyzer

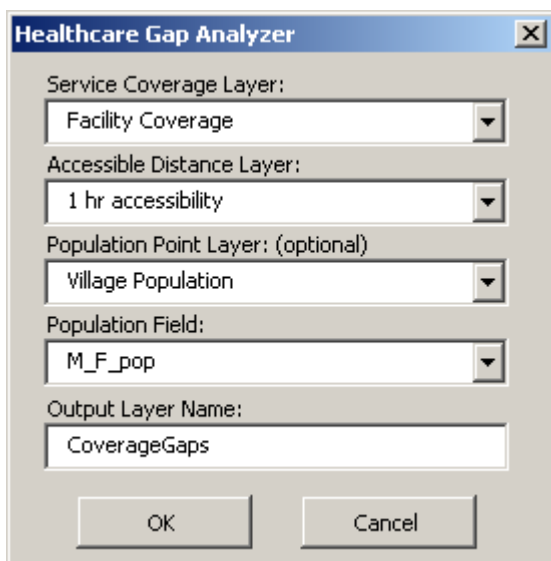
Purpose: The **Healthcare Gap Analyzer** examines areas where gaps in healthcare coverage exist. It analyzes the difference between the accessible region around a facility (either defined through a standard buffer calculation or via the *Facility Accessibility Mapper*) and the area a facility is currently expected to cover (based on the *Service Network Provider*). The total population that falls within each gap region can be calculated, allowing for prioritization of target areas for intervention.

Directions:

- 1 Select **Healthcare Gap Analyzer** from the Health Toolkit drop down menu.

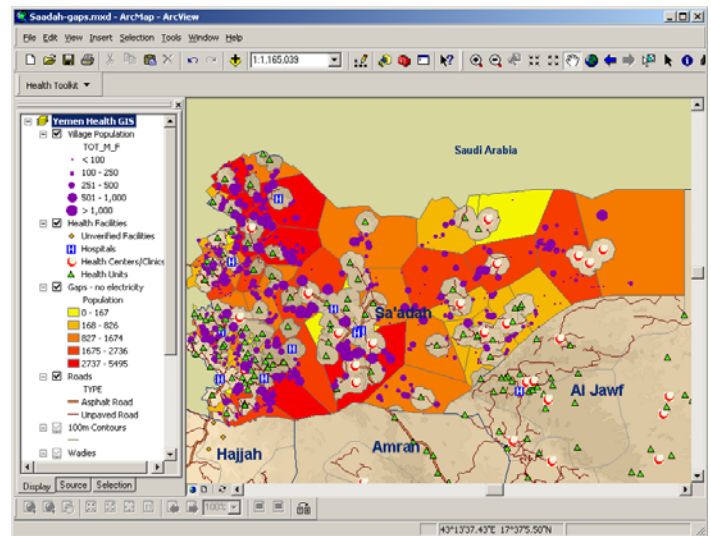


- 2 In the Service Coverage layer dropdown, select the output layer from the *Service Network Provider*. Then select the Accessible Distance layer, which is either the output layer from the *Facility Accessibility Mapper* or from the standard distance-based buffer tool built into ArcGIS. For best results, this tool should be run using a Service Coverage layer and an Accessible Distance layer that were both derived from the same set of facility points.



Optionally, you can add a point file, such as a Villages layer, that contains population data and select the file's population count field. The program will then sum up the total population living within each identified gap area and summarize this in a column in the output dataset. Leave these drop-down options blank if you do not wish to create a population based summary.

- 3 Enter a name (with no file extension) for the output file and click 'Ok'. The file will be generated and added to the map document. It will also be saved in the C:\YemenHealth GIS\UserData folder for later retrieval. Open the output file's attribute table to view the Population summary field. You can also use this field as a basis for map classification (e.g. use color symbology to classify the gap areas by population size).



Uses: The **Healthcare Gap Analyzer** extends the capabilities of a suite of tools provided in the Health GIS toolkit. By using the *Facility Survey Analyzer* to pre-select a set of facilities of interest, then generating the user-defined accessible region around each facility through the *Facility Accessibility Mapper* and calculating the current required coverage area of each facility through the *Service Network Provider*, the **Healthcare Gap Analyzer** can integrate the results together by identifying and totaling the populations that are not currently being served. In this manner, underserved populations can be profiled, prioritized, and targeted more effectively on the basis of geospatial considerations in combination with traditional health statistical techniques. Equitable health care decisions can be greatly enhanced using this evidence-based approach. Results can be used to track and monitor changes in coverage and performance (area- and population-based) for the existing health system and as a result of future health care interventions.

Health GIS Toolkit: Immunization Manager

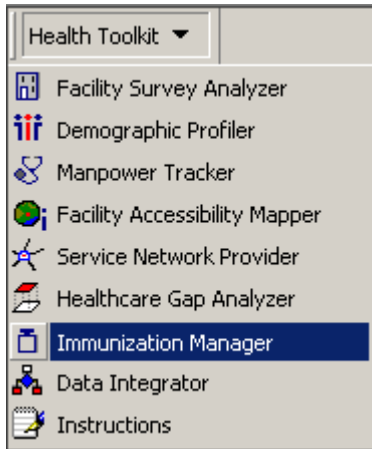
Purpose: The **Immunization Manager** integrates monthly/quarterly reports of immunization rates from a District immunization management information system (MIS) and/or other tracking systems. The tool produces a series of layers that map immunization rates across the time period covered in the immunization dataset of interest.

Directions:

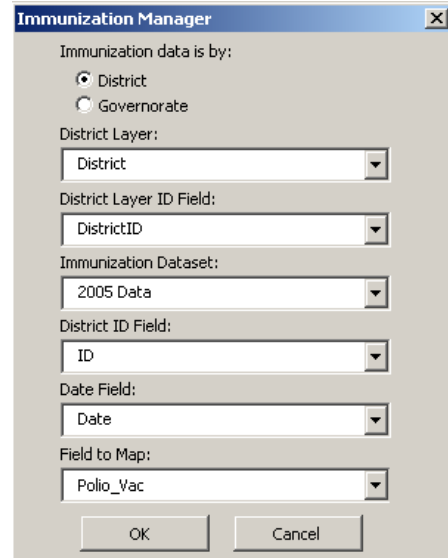
1 Add your immunization dataset (MS Access or .dbf format) to the GIS. This dataset must contain columns for: 1) governorate or district ID (field type: number); 2) date (field type: text); and 3) numeric attribute field(s) to map (e.g. polio vaccine counts). Each district or governorate should have an entry for each date, for example:

DistrictID	DistrictName	Date	Polio_Vac
2915	Amran	Jan-06	1152
2918	Iyal Surayh	Jan-06	217
2915	Amran	Feb-06	1349
2918	Iyal Surayh	Feb-06	261

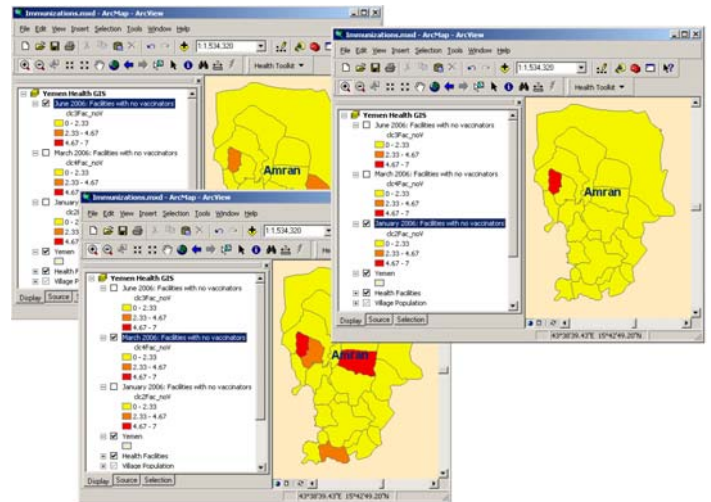
2 Select **Immunization Manager** from the Health Toolkit drop down menu.



3 Select the geographic level of your data. Depending on geographic level selected, choose the Governorate or District layer from the map and then locate its ID field. Then select the Immunization Dataset that you added to the GIS. For this dataset, locate its ID field, date field and the attribute field that you want to map.



4 Click 'Ok' to generate the time series layers. For each unique date listed in the date field, a layer will be added to the top of the map's table of contents. All layers are mapped according to the same range of values, allowing for cross-comparison. By turning on and off these layers, you can visualize changing immunization rates across time.



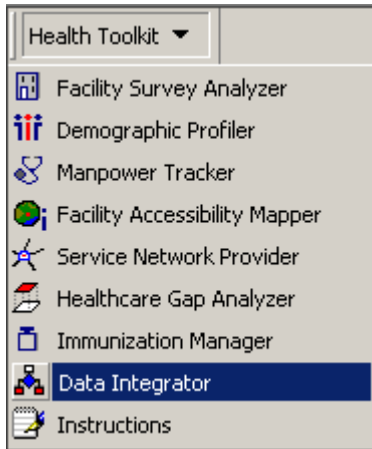
Uses: The **Immunization Manager** can perform rapid visualization of immunization patterns across critical populations (e.g., children under one, pregnant women, or women of child-bearing age) occurring at the sub-national level over time. Immunization MIS results mapped using the **Immunization Manager** can be used to more accurately target populations, project vaccine needs, compute immunization coverage, and evaluate performance of individual facilities and districts. Results can also be used to inform health care planning decisions when supplemented with vaccine cold chain gap results evaluated using the **Healthcare Gap Analyzer**.

Health GIS Toolkit: Data Integrator

Purpose: Any type of data that is available by governorate, district or health facility can be joined into the Yemen Health GIS and mapped. However, to be used in the GIS, the user's dataset must contain the identification (ID) number of the administrative boundary or facility. For datasets that lack this common ID field, the **Data Integrator** attaches the ID field to the user's dataset by matching the text in the name field to the most likely match in the reference dataset's name field. Differences in spelling due to variations in translation of Arabic place names into English are taken into consideration during the matching process.

Directions:

- 1 Add your dataset (MS Access or .dbf format) to the GIS.
- 2 Select the **Data Integrator** from the Health Toolkit drop down menu.



- 3 The first tab of the **Data Integrator** contains the 'required inputs' for the tool. You must: 1) define the geographic level of the data; 2) select the dataset that was added to the GIS in Step 1 and identify its name field; and 3) select the reference dataset, which is the governorate, district or health facility layer included in the GIS. For the reference dataset, you must define the name field (for matching to user's dataset name field) and the ID field (for copying into the user's dataset).

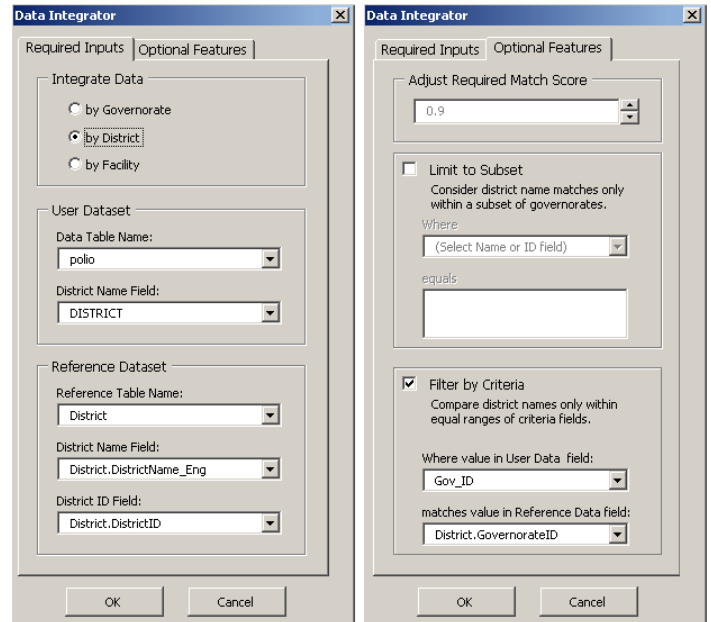
The 'optional features' tab has several items that will assist you in creating a more accurate match for your data:

Adjust Required Match Score: By default, for each record the program copies the appropriate ID to the user's dataset when it calculates that there is at least a 90% likelihood that the match of the name fields is correct. You can adjust this value if you feel that 90% is too accepting or too limiting for your particular dataset. One approach is to run the **Data Integrator** first with the default match score (0.9), then spot check your results to test for accuracy, and if necessary adjust the required match score (higher or lower) and re-run the tool.

Limit to Subset: If your district level data is for a specific set of governorate(s) or your facility data is for specific district(s) or

governorate(s), you can limit the search for a suitable match to names that occur only in the districts or governorates you specify. This ensures that matches are not made to names that occur outside the geographic region of your data.

Filter by Criteria: If your district or facility dataset contains a governorate field, it can be used as a filter during the matching process. (Note that facilities can also be filtered by district.) In this case, the program only considers matches for district or facility names within the context of its governorate.



- 4 When you run the **Data Integrator**, you will get a pop-up message that says how many records were processed and how many records were matched. Open your data table and you will see three new columns: MATCH, MATCHID and MSCORE. For any MSCORE that falls below the 'Required Match Score', the MATCH and MATCHID fields will be blank. If a large portion of your dataset did not receive a match, you can try lowering the match score below 90% and re-running the tool. You can also take the remaining, hard-to-match items and match those manually to complete your ID field list. Your dataset will then be ready for joining into the GIS.

Uses: The **Data Integrator** is designed to reduce the time it takes to manually update a user's dataset with suitable ID fields by automating much of the process. Facility data that have district and governorate classifications can even be run through the **Data Integrator** multiple times to get to a more exact match at the facility level: firstly, by matching the governorate names to generate the governorate ID field, then using the Governorate IDs as a filter for finding a better match for the district names, then using District IDs as the most precise filter for matching facility names. For users who will repeatedly add their own data updates to the GIS, the **Data Integrator** would only need to be run once in order to attach valid IDs to the user's dataset. Future updates of the user's data can then be added to the ID-linked version of the user dataset.