WHONET Training Course

Module 6 – Quick analysis and standard reports

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Surveillance of Antimicrobial Resistance

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**WHONET – Getting Started - Exercises**

In Module 4 and 5, you learned how to use the interactive “Data analysis” module to select your analysis parameters, such as “Analysis type”, “Organisms”, “Data files”, and “Isolate filters”. You have full control over the WHONET options. You also saw the value of creating “WHONET macros” for analyses that you plan to run repeatedly.

In Module 6, you learned about the WHONET “Quick analysis” feature, which offers both “WHONET Standard reports” created by the WHONET team in Boston and “User-defined reports” that you can create. Such reports can be useful on a daily, weekly, monthly, quarterly, and/or yearly basis and customized for different audiences, such as microbiologists, pharmacy and infection control staff, national epidemiologists, and other stakeholders.

1. **WHONET Standard reports designed for the screen and Microsoft Excel**

* Open WHONET, select the “WHONET Test laboratory” and “Open laboratory”.
* From the main menu, select “Data analysis” and the option “Quick analysis”.
* You will now see options for:
  + “WHONET Standard reports” – Created by the WHONET Team in Boston
  + “User-defined reports” – Reports that use “Macros” that you created in “Data analysis”.
  + DHIS2 – Options for exporting data to the widely used DHIS2 public health surveillance platform, [dhis2.org](https://dhis2.org). The DHIS2 features of WHONET are not covered in this training course, but you can learn more from tutorials available on the WHONET Training Center.
* Select the report for “Organism and antibiotic statistics”.
* Click on “Data file” and select the file WHO-TST-2000-01.sqlite.
* For output, the default is “Screen”. Leave this unchanged.
* Click on “Begin analysis”.
* WHONET will run a large number of macros related to the organism statistics and a series of stratification variables. The first analysis is “Organism by laboratory”. There is one row for each organism, columns for the total “Number of isolates” and “Number of patients” and the “Number of patients by laboratory” (especially useful if analyzing data from a surveillance network).
* You can click on “Number of patients” twice, and the most common organisms will be sorted to the top of the screen. The four most common in this database are coagulate-negative staphylococci (scn), *Escherichia coli* (eco), *Staphylococcus aureus* (sau), and *Enterococcus* sp. (ent).
* In the lower right area of the screen, click on the laboratory code “tst”, and you will see a graph with the distribution of organisms for this laboratory, including those four most common organisms listed above.
* When you have finished reviewing the results, you can click on “Copy table”, “Copy graph”, “Save table” or “Save graph” to transfer the results to other softwares, such as Microsoft Excel or PowerPoint.
* Click on “Continue” to proceed to the next analysis.
* WHONET will then proceed with other macros about the organism details including stratification by sex, age group, location, location type, and specimen type. Click on “Continue” after each analysis to advance to the next screen.
  + Specimen date by month: Generally, you would see the results of each species over each month of the year, which can be useful to find possible outbreaks. However, the data file that you are analyzing only include data for one month, all of the results that you observe are from January.
  + Sex: Click on the graph for *Escherichia coli* (eco), and you will see that this organism is much more common in samples from females than in males reflecting the high occurrence of this organism in urinary tract infections in women. Click on the graph for *Staphylococcus aureus* (sau), and you will see that the distribution of results between male and female isolates is much more similar.
  + Age group: Click on the graph for *Escherichia coli*, and you will see the age distribution for patients with this organism.
  + Location: This refers to the precise patient location such as “Cardiology / card” or “Emergency Room / er”. Click on the graph for “Escherichia coli” to see the location distribution for this organism (predominantly from outpatients and the emergency room. Click on the location “Surgical Intensive Care Unit / sicu”, and you will see that the most common pathogen is *Stenotrophomonas maltophilia*, which could suggest a possible hygiene issue with this organism in this location.
  + Location type: This refers to the general location category such as “Inpatient / in”, “Outpatient / out”, “Intensive Care Unit / icu”, or “Emergency Room / eme”. Click on the graph for *Proteus mirabilis*, and you will see that this organism was most common in the intensive care units (a bit surprisingly since this is generally considered predominantly a community pathogen). Click on the graph for “Intensive care units / icu”, and you will see that the most common organism is “*Enterococcus* sp. / ent”.
  + Specimen type: Click on the graph for “*Escherichia coli* / eco”, and you will see that this organism is predominantly recovered from “Urine” samples, while *“Haemophilus influenzae*” was only isolates in “Sputum” samples. Click on the graph for “Blood”, and you will see that the most common organism is “Staphylococcus, coagulase-negative / scn”. While some of these may be true pathogens, this organism is also frequently associated with contaminated samples due to deficiencies in sample collection practices.
* Antibiotic statistics. Continuing from the preceding analyses for organism statistics, click on “Continue” to advance to each of the outputs with the antibiotic statistics.
  + %RIS analysis of *Staphylococcus aureus*. You see the details %RIS analysis results, as you saw earlier in the exercises for Module 5. A good place to start interpreting the results is to click on the graph for “Number tested”, and you will see: 1) the antibiotics that the laboratory is testing; and 2) how often each antibiotic tested, which may suggest laboratory practices for selecting testing or reflect problems with stock outages of antimicrobial disks. Click on “Continue” to see the same kind of results for *Escherichia coli*.
  + Gram-positive antibiogram. You will see the %Susceptible summary “antibiogram” for Gram-positive organisms. You can click on “Number of isolates twice to see the most common organisms listed at the top of the table. Click on “Continue to see the same kind of results for the Gram-negative bacteria. In the Gram-negative antibiogram, click on the graph for ampicillin, and you can observe those organisms that possess intrinsic resistance to ampicillin where the %Susceptible is 0% or very low, such as organisms from the genera *Klebsiella*, *Enterobacter*, *Citrobacter*, and *Pseudomonas*. You can also see those organisms that do not have intrinsic resistance but may have acquired resistance such as *Escherichia coli* (eco) and *Proteus mirabilis* (pmi).
  + Click on “Continue” and you will return to the main screen for Quick analysis.
* Now that you have completed the analyses for this report and visualized the results on the screen, change the output to Excel. WHONET will suggest a name for the new Excel file including the name of the report and the date that you run the analysis. By default, these will be saved in the C:\WHONET\Output folder.
* Click on “Begin analysis”, and WHONET will repeat all of the analyses that you viewed above and save the results directly to Excel.
* When WHONET has finished, it will ask you if you would like to open the file in Excel. Click “Yes”. The file might open immediately on the screen in Excel, but if it does not, click on the Excel icon at the bottom of your screen.
  + If you receive an error message, this could represent an incompatibility between your version of WHONET (32-bits or 64-bits) and your version of Microsoft Office (32-bits or 64-bits). For best compatibility, the versions should be aligned (32-bits with 32-bits or 64-bits with 64-bits). Further details can be found about this issue at [whonet.org/Excel.html](https://whonet.org/Excel.html)
* You will see an Excel file with one sheet corresponding to each of the analyses presented above: Organism by laboratory, sex, age group, *etc*. Click on some of these sheets, and you will see the data table at the top of the sheet and the corresponding graphs underneath.
* This Excel file can easily be shared with colleagues inside and outside the laboratory for their review.
* When you have finished reviewing the contents of the Excel file, close Excel, and return to WHONET. You should now be back at the main screen for Quick analysis.

1. **WHONET Standard reports for Microsoft Word – Epidemiology report**

Some of the WHONET standard reports have been optimized for Microsoft Word. They include much descriptive text and guidance about the data presented in a format that is very valuable for your collaborators. Instead of presenting the large volumes of data that you saw in the previous reports designed for the screen and Excel, these Word reports will show only the most important results and the most common results, which is sufficient for the purposes of many interested partners.

* Select the “Epidemiology report” and “Begin analysis”.
* WHONET will run a large number of analyses and summarize the results into a single Word document. When WHONET has finished, you will be asked if you want to open the file. If Word does not open directly, then click on the Word icon at the bottom of the screen.
  + If you do receive an error message or if the Word document does not exist, there could be a compatibility issue between your versions of WHONET and Microsoft Office, as mentioned previously for Excel. The same guidance and link provided above for Excel would also be relevant for Word,
* The Word document includes a title page and a table of contents covering many analysis areas:
  + Data volume: This presents the total number of isolates and patients and their distribution by laboratory and over time.
  + Patient and sample details: There are tables and graphs summarizing patient demographics (sex and age group), location and location type details, and sample types.
  + Organism statistics: There tables present the most frequent organisms overall and by specific specimen categories. The section also highlights isolates with “Important species” alerts, such as *Neisseria meningitidis* (high priority). There is a table for organisms with an increasing linear trend over time – however, this requires multiple months of data, and in this exercise, we are only analyzing data from a single month.
  + Antimicrobial statistics: The section presents “Important species” alerts and tabulations of multidrug resistance in two ways:
    - Definitions proposed by the European Centres for Disease Prevention and Control (ECDC) based on the number of antibiotic categories to which the organism is nonsusceptible. This type of presentation is especially valuable for purposes of advocacy and awareness of the growing threat of multidrug resistance.
    - WHONET resistance profiles indicating the frequency of organisms categories by their precise multidrug resistance profile, which is of particular value to infection control staff in the tracking and containment of multi-resistant clones and timely recognition of possible outbreaks based on the observed phenotypes.
  + Reporting to the World Health Organization and the United Nations. This section tabulates metrics according to the WHO GLASS protocol (Global Antimicrobial resistance and use Surveillance System), as well as the UN Sustainable Development Goal indicators for monitoring resistance trends.
  + Cluster detection. As a short demonstration of the capabilities of SaTScan for cluster detection, this section explores for clusters:
    - By organism utilizing all species, and two statistical clusters were identified, one for *Corynebacterium* species and one for *Klebsiella pneumoniae*; and
    - By resistance profile specifically for *Staphylococcus aureus* (with a single cluster of four patients with isolates nonsusceptiblly only to erythromycin on one day) and *Escherichia coli* (no clusters detected in this small database of only one month).
  + Antibiograms. The Appendix includes formatted antibiograms for both Gram-positive and Gram-negative organisms. While the recommendation of CLSI and others is to exclude organisms and antibiotics with fewer than 30 results, in WHONET we have implemented a minimum threshold of 20 isolates to offer more information to the data analyst, who can then choose whether to remove these organisms with fewer than 30 isolates.
* Read through the Word document to become familiar with its contents.
* When you have finished, close the Word document to return to the Quick analysis screen in WHONET.

1. **WHONET Standard reports for Microsoft Word – Test practices and data quality report**

* Select the “Test practices and data quality report” and “Begin analysis”.
* WHONET will run a large number of analyses and summarize the results into a single Word document. When WHONET has finished, you will be asked if you want to open the file. If Word does not open directly, then click on the Word icon at the bottom of the screen.
* The Word document includes a title page and a table of contents covering many analysis areas:
  + Data volume: This presents the total number of isolates and patients and their distribution by laboratory and over time. It also includes a table summarizing “percent completeness” and “percent use of valid WHONET codes” for key data fields, such as “identification number”, “location”, “specimen date”, and “specimen type”.
  + Quality control testing. This section provides statistics on standard quality control strains tested, such as ATCC 25922 *Escherichia coli*, and their results.
  + Organism results: This section explore organism identification from a quality perspective, including the ability and practices of a laboratory to identify organisms to the precise species or only to the genus level. One table presents statistics on the number of isolates of fastidious organisms identified, including a number of respiratory pathogens, anaerobes, and other organisms difficult to grow and/or identify.
  + Antimicrobial susceptibility test practices: This section presents tables that summarize some of the test practices for antimicrobial susceptibility testing, such as: which antibiotics are testing and how frequently? are there test results for antibiotics without valid published breakpoints? How frequently does the laboratory record test measurements (zone diameters and MIC values) as opposed to test interpretation categories (resistant, intermediate, susceptible).
  + Quality control alerts: This final section presents a summary of “microbiology alerts” categorized as quality control alert, such as *Klebsiella pneumoniae* susceptible to ampicillin (the expect result is resistant) or *Streptococcus pneumoniae* tested with the penicillin disk (it should be tested with either an oxacillin disk or a penicillin MIC). If data from multiple laboratories are tested, results will be tabulated separately for each laboratory.

1. **User-defined Reports**

The previous exercises explored the use of standard reports defined by the WHONET Team in Boston. In this section, you can create your own reports with the content needed by your stakeholders – which organisms, analyses, filters, and output formats. At the present time, you can create our own reports designed for the screen or for Excel. In future versions of WHONET, you will also be able to customize your own Word reports.

* 1. Creating a user-defined report
* In the Quick Analysis screen, click on “New”.
* At the top of the screen, give a name to the new report, for example “Antibiogram report”.
* On the left side of the screen, you will see a list of all macros that you have created previously. If you followed the exercises for Module 4, then you should have two macros called “Gram-positive antibiogram” and “Gram-negative antibiogram”.
* Select both of these macros, moving them to the right side of the screen. You can also use “Move up” or “Move down” to change the sequence of the macros if you would like. You can use the left arrow in the middle of the screen to remove a macro.
* After you have selected the macros, click on “Save”. By default, the name of this file will be “Monthly report.rpt”, and the file will be saved in C:\WHONET\Macros.
* Click on “Exit” to return to the main screen for Quick analysis.
* You can click on “Edit” if you would like to review the work that you have done or to make modifications. Other options include “Rename”, “Delete”, and “Copy”.

* 1. Running a user-defined report
* Click on the report that you have just created.
* Click on “Data files” and select the file “WHO-TST-2000-01.sqlite”.
* Click on “Begin analysis”. You will now see the results of the macro appearing on the screen, just as they appeared in the exercises for Module 4.
* When you have finished reviewing the results of the first macro, click on “Continue” to advance to the results of the second macro”.
* When you have finished reviewing the results of the second macro, click on “Continue” to return to the main screen for Quick analysis.
* Now change the output from “Screen” to “Excel” and click on “Begin analysis”. WHONET will create a file with the name of the report (“Monthly report”) and the date on which you ran the analysis.
* When the analysis is finished, WHONET will ask you if you want to open the file. Answer “Yes”. If you do not see the Excel file immediately, click on the Excel icon at the bottom of the screen.
* You will see that the Excel file has two sheets, corresponding to the results of the two macros – one for the Gram-positive antibiogram and one for the Gram-negative antibiogra. Review the results. When you have finished, close Excel to return to WHONET.
* Click on “Exit” to leave the main screen for Quick analysis.
* Click on “File” and “Exit” to leave WHONET.

And congratulations! You have just finished the WHONET Training Course. If you have suggestions or comments, please write to the WHONET team at [help@whonet.org](mailto:help@whonet.org).