

BacLink

Exporting data from an LIS (Laboratory Information Systems)



**WHO Collaborating Centre for
Surveillance of Antimicrobial Resistance**

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BacLink Tutorial - Laboratory information systems

The document covers the following areas:

- Part 1. What are WHONET and BacLink?
- Part 2. What does the laboratory need from the IT Department to run WHONET?
- Part 3. What information should be in the export file?
- Part 4. How should the information be organized?
- Part 5. How often should data be exported?
- Part 6. What comes next?

The purpose of this document is to describe to IT staff the purpose of the WHONET and BacLink softwares, and how they may be useful to the laboratory staff, clinicians, pharmacists, and infection control staff in your institution. The document also provides instructions to IT staff on what laboratory staff will need to implement WHONET and BacLink.

Part 1. What are WHONET and BacLink?

WHONET is a free Windows-based desktop application developed by the WHO Collaborating Centre for Surveillance of Antimicrobial Resistance for the laboratory-based surveillance of infectious diseases and antimicrobial resistance.

The principal goals of the software are:

- to enhance capabilities for analyzing laboratory data; and
- to promote national and international collaboration through the exchange of data.

The software is used in over 80 countries around the world managing data from over 1000 clinical, public health, veterinary, and food laboratories. WHONET can be used by individual laboratories or as part of national and international surveillance networks.

Many laboratories around the world already have well-established computer databases that meet the day-to-day needs of clinical reporting, specimen processing, and long-term data storage. Unfortunately most of these systems have limited capacity for sophisticated data analysis. It is in these areas that WHONET is a valuable supplement to existing systems.

This purpose of the BacLink software is the conversion and standardization of microbiology data from existing systems into WHONET. You can convert data on a weekly, monthly, or *ad hoc* basis, or in a number of institutions, it has also been possible to automate and schedule the entire process. Both WHONET and BacLink, available in 17 languages, can be downloaded from the World Health Organization website: www.who.int/drugresistance/whonetsoftware.

By converting data to WHONET, laboratories have the benefits of: 1. flexible data analysis capabilities; and 2. the ability to share data with other laboratories, for example in a national surveillance network.

Part 2 – What does the laboratory need from the IT Department to run WHONET?

Since BacLink cannot access the internal databases of your laboratory information system (LIS), the laboratory needs a data file exported from your system with the desired patient information and microbiological results. In many institutions, the most convenient type of file to create is a simple delimited text file, though BacLink can also accept a number of other formats. Information to be included in this export is suggested in Part 3, and the organization of the data in the file is discussed in Part 4.

Fortunately, most information systems do have the capability of creating such text files using existing data export, report, or interface options. In the case of the following systems, we have prepared detailed instructions and report templates that you should be able to apply directly:

- Meditech Magic
- Cerner Classic

It is also possible to convert data from the following systems, but we have not developed formal documentation describing the process. For further details, please contact us directly.

- ADBakt (Sweden, Denmark)
- MADS (Denmark)
- Oman Health Information System (Oman)
- WinPath (Malaysia)

If you do not have any of the systems indicated above, then you should try to create a delimited text file with the information described below.

Our group is currently working on the development of interface options for Meditech Client/Server, Cerner Millennium, and Mysis. If you would like to assist in the development or testing of interfaces for these systems or any other system, please contact John Stelling at jstelling@rics.bwh.harvard.edu.

Part 3. What information should be in the export file?

Data fields

The following is a list of suggested data fields to be included in the export. The precise list should be discussed with laboratory staff, and should reflect the information available in your system and the data analysis needs of clinical staff. All of the fields are optional, though a few are highly recommended. Feel free to delete any fields which are unneeded and add additional fields that you desire.

Patient fields:

- Identification number (e.g. Medical record number) – recommended
- Patient first name and last name *or* Patient full name
- Sex
- Date of birth and/or age
- Date of admission

Location fields

- Patient location (ward or clinic) – recommended
- Department or specialty
- Institution or facility (in the case of a laboratory serving multiple institutions)
- Type of location (for example, inpatient or outpatient)

Specimen fields

- Specimen or accession number – recommended
- Specimen collection date – recommended
- Specimen type (blood, urine, cerebrospinal fluid, *etc.*) – recommended

Organism results

- Organism – recommended
- Antimicrobial susceptibility test results – recommended

Most of the above fields are self-explanatory. For antimicrobial susceptibility test results, a few additional comments are needed.

The three most common methods for performing antimicrobial susceptibility tests are:

1. Disk diffusion, also known as Kirby-Bauer. Results are measured in millimeters.
2. MIC determination. MIC = minimal inhibitory concentration. In routine laboratories, MICs are usually determined with automated susceptibility test instruments, such as MicroScan, Sensititre, and Vitek. Quantitative results are given in the form of a concentration, for example micrograms/milliliter ($\mu\text{g/ml}$).
3. Etest. This is a specialized version of a MIC test. It is a more expensive test than routine MIC tests. Results are also measured as concentrations, for example ($\mu\text{g/ml}$).

Laboratories may perform one, two, or all three of these methods. Some laboratories enter the quantitative test measurements directly into the computer system (millimeters or $\mu\text{g/ml}$) or the test interpretation (resistant, intermediate, or susceptible) or both. Examples of how you could export the antibiotic results are provided in Part 4.

There are some additional specialized antibiotic tests that you should also try to export if feasible: beta-lactamase, ESBL, Dtest, *etc.* In many computer systems, these tests are treated in the same way as other antimicrobial tests, so no special handling is required to capture the results. In other systems, results are saved internally in a separate field that you should try to capture.

Data codes and date formats

BacLink has a flexible interface for mapping data codes and date formats. So you should export whatever codes and values are most convenient for you and your laboratory staff. If you have the choice between exporting a data code (*e.g.* UR) or the corresponding full text (URINE), the full text will probably be more convenient for the users who will do the code mapping.

What specimens should be included in the export file?

When you export results from your LIS, you can export results from all specimens or from a subset of specimens. The three most common options would be:

1. All specimens
2. All “positive” specimens (do not include specimens with “No growth”)
3. All “positive” specimens with antimicrobial susceptibility test results

Any of these approaches are reasonable options. The first approach will have the most information available for analysis, but these files can also be very large because of the large number of “negative” results. Option 2 is a reasonable compromise for many laboratories between the value of the information, the size of the data file, and the speed of data analysis.

Part 4. How should the information be organized?

File format

Most institutions find the use of delimited text files to be the most convenient means of exporting data to WHONET. The choice of field delimiter (comma, tab, semi-colon, *etc.*) is configurable by the user. Other options include fixed-column text, Microsoft Access, or dBASE. The use of a file header (the first row of the file indicates the names of the data fields) is often convenient for the data manager, but is not a requirement.

BacLink works with “flat” non-relational databases. Create one column for each of the fields that you intend to export: medical record number, patient location, collection date, organism, *etc.*

Antibiotic results – organization of records

Because each bacterial isolate is usually tested against multiple antibiotics and perhaps by one than one test method, there are a few possible acceptable ways of organizing your antibiotic test results in the export file. The two most common variations are described below. You should decide which of these two approaches would be easiest to implement and maintain in your system.

1. One isolate per row: Each row in the export file corresponds to the results from one organism. All results from this organism are saved in this one record. People entering data manually into Excel usually organize their data in this way – with all of the antibiotic results for one organism saved as part of the same record/data row. Some hospital systems also export data in this way.

Example:

First name, Last name, Sex, Location, Specimen type, Specimen date, Organism, PEN, ERY, VAN
John, Smith, Male, Neurology, Blood, 1/1/2006, S. aureus, R, R, S
Mary, Jones, Female, Nursery, CSF, 3/10/2006, S. pneumoniae, S, S, S
Tom, Brown, Male, ICU, Wound, 5/8/2006, C. albicans

The last record illustrates an isolate in which no antibiotics were tested.

2. One antibiotic result per row: Each row in the export file corresponds to one antibiotic test result. So if an organism is tested against 12 antibiotics, this organism would require 12 records in the export file. This approach is very commonly used when exporting data from relational databases, such as those common in LIS softwares or laboratory instruments.

Example

```
First name, Last name, Sex, Location, Specimen type, Specimen date, Organism, Antibiotic, Result
John, Smith, Male, Neurology, Blood, 1/1/2006, S. aureus, PEN, R
John, Smith, Male, Neurology, Blood, 1/1/2006, S. aureus, ERY, R
John, Smith, Male, Neurology, Blood, 1/1/2006, S. aureus, VAN, S
Mary, Jones, Female, Nursery, CSF, 3/10/2006, S. pneumo, PEN, S
Mary, Jones, Female, Nursery, CSF, 3/10/2006, S. pneumo, ERY, S
Mary, Jones, Female, Nursery, CSF, 3/10/2006, S. pneumo, VAN, S
Tom, Brown, Male, ICU, Wound, 5/8/2006, C. albicans
```

An advantage of the first approach is that files are much smaller in size; these files are also easy to manage in Excel and other data management softwares. An advantage of the second approach is that it is often easier to maintain in the long-term as additional antibiotics are added to the database. If the laboratory starts testing a new antibiotic, the first approach would require the programmer to add new columns to the data export, and if this is not done, the new antibiotic will not be captured. In the second approach, new antibiotics will generally show up automatically as additional rows in the export file, requiring no change in the structure of the data file.

Antibiotic results – test measurements and test interpretations

As mentioned above, it is possible to export test measurements (mm or µg/ml), test interpretations (resistant, intermediate, or susceptible), or both to the export files. If you have both, you should export both if possible. If you must decide between the two, the measurement is more valuable since the interpretation can be deduced from the measurement.

Example with disk diffusion data – exporting the measurement and the interpretation

```
First name, Last name, Specimen type, Specimen date, Organism, Antibiotic, Measurement, Interp.
John, Smith, Blood, 1/1/2006, S. aureus, PEN, 6, R
John, Smith, Blood, 1/1/2006, S. aureus, ERY, 10, R
John, Smith, Blood, 1/1/2006, S. aureus, VAN, 19, S
```

Example with MIC data – exporting the measurement and the interpretation

```
First name, Last name, Specimen type, Specimen date, Organism, Antibiotic, Measurement, Interp.
Mary, Jones, CSF, 3/10/2006, S. pneumo, PEN, 0.064, S
Mary, Jones, CSF, 3/10/2006, S. pneumo, ERY, <=0.25, S
Mary, Jones, CSF, 3/10/2006, S. pneumo, VAN, 1, S
```

Antibiotic results – test methods

If your laboratory only uses one test method, then there is no need for you to indicate the test method in the exported data file, as in the examples given above. On the other

hand, if your laboratory does testing by more than one method, then you should also try to indicate the test method in the exported data file.

Example with disk and MIC data

```
First name, Last name, Specimen type, Specimen date, Organism, Antibiotic, Method, Measurement, Interp.  
John, Smith, Blood, 1/1/2006, S. aureus, Disk, PEN, 6, R  
John, Smith, Blood, 1/1/2006, S. aureus, Disk, ERY, 10, R  
John, Smith, Blood, 1/1/2006, S. aureus, Disk, VAN, 19, S  
Mary, Jones, CSF, 3/10/2006, S. pneumo, MIC, PEN, 0.064, S  
Mary, Jones, CSF, 3/10/2006, S. pneumo, MIC, ERY, <=0.25, S  
Mary, Jones, CSF, 3/10/2006, S. pneumo, MIC, VAN, 1, S  
Tom, Brown, Wound, 5/8/2006, C. albicans
```

For many laboratories, this last example presented could be a useful model to emulate when you develop your export routine. In addition to the fields shown in this example, you should also export the other relevant fields described earlier.

Part 5. How often should data be exported?

The frequency of data exports will depend on how often the laboratory staff would like to update their databases for analysis. If the focus is only on general trends in infection and resistance, then once a quarter or once a year may be adequate. However, if there is interest in tying data analysis to prompt outbreak detection and isolate alerts, then a monthly or weekly export would be more appropriate.

An automated daily download and analysis would be the ideal solution. This has been implemented in a few institutions, and we are currently working on interface tools to make this a more viable option for laboratories, but at the present time, most laboratories accomplish the data conversions and analyses interactively on a weekly, monthly, or quarterly basis.

For information on the use of BacLink in automated batch mode, please contact us directly for details at jstelling@rics.bwh.harvard.edu.

Part 6. What comes next?

If you succeed in creating a text file with the information described above, the next step is to use BacLink to convert the text file to the WHONET data format. This can be accomplished by the IT Department, by the laboratory, or by both groups in collaboration. For information on how to get started with BacLink, continue with the tutorial on “BacLink – Getting started”.

If you have any questions about BacLink or WHONET, feel free to contact us at jstelling@rics.bwh.harvard.edu. If you would like to assist us in the development of additional interface options for BacLink, we would also be very glad to hear from you.