

Cerner Millennium Auto No Growth Function with BACTEC and EpiCenter

While Cerner Millennium does not directly accept and post the test level result LIS messages sent from BACTEC or EpiCenter for BACTEC tests, it can use the messages indirectly to control the posting of results using the Auto No Growth (ANG) function in Millennium. Clarian Pathology Lab in Indianapolis had been using the messages generated from BACTEC with a direct interface. There was a need to move them to using EpiCenter while keeping their workflow intact and to match the LIS messages sent from EpiCenter to be as close as possible to the LIS messages previously sent by BACTEC. In the process of matching these LIS messages, we gained a better understanding of how Millennium can use these messages for the ANG function.

The interface at Clarian was configured to use BDMODEM. ASTM messages were not tested, but should work in the same manner provided that field mapping is correct.

EpiCenter configuration:

EpiCenter v5.53 or higher must be installed. The LISTier2.exe file dated 1/28/08 must be installed in the C:\Pegasus\Tier2 folder.

The interface was enabled, configured to use BDMODEM and set to Emulate BACTEC 9000 LIS interface.

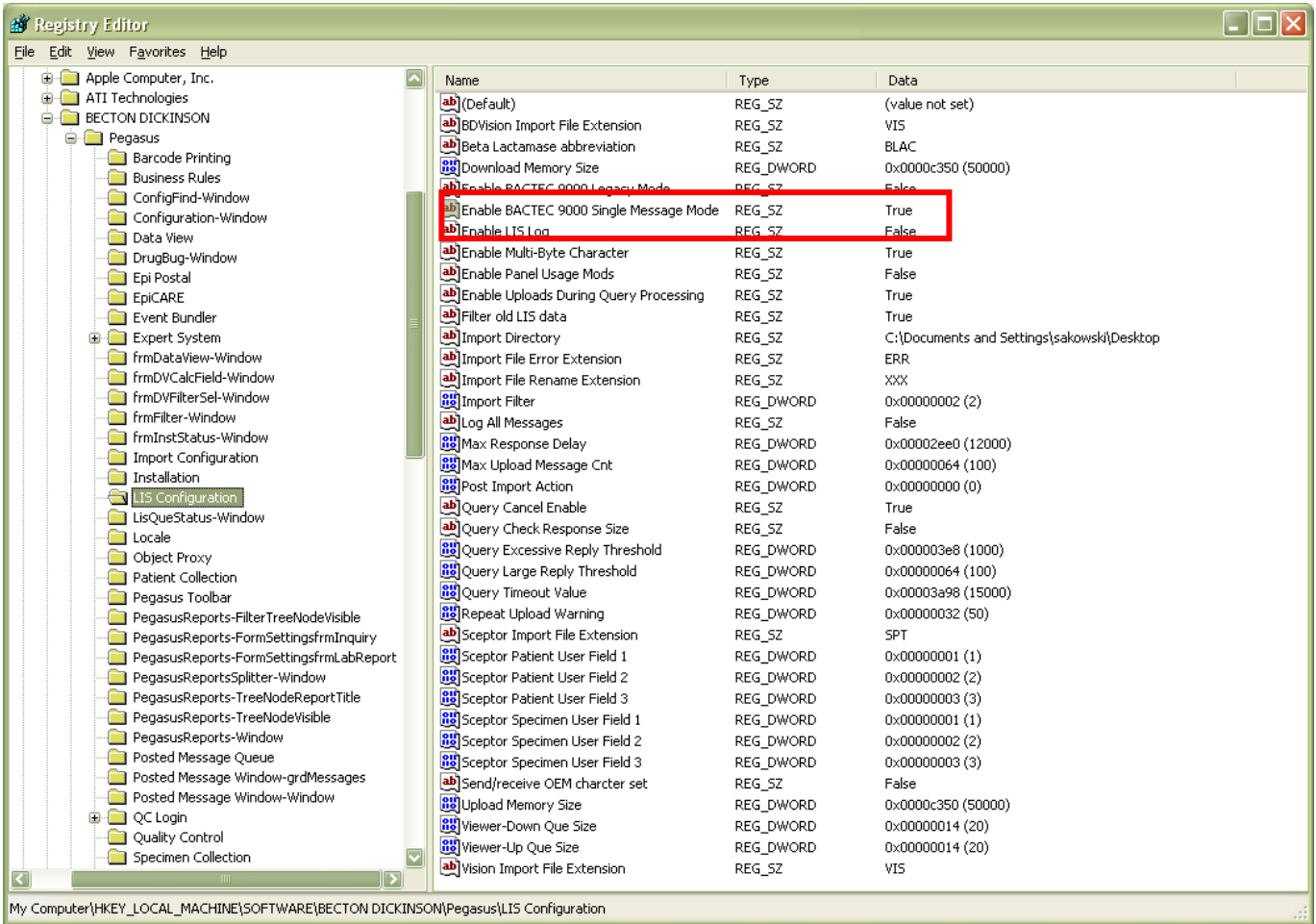
The screenshot shows the 'Configuration' window in Cerner Millennium. The left sidebar lists 'Configurable Items' including System Users, System Parameters, System Messages, LIS Parameters (selected), LIS Field Map, Instruments, Antimicrobials, Organisms, Expert System, Barcode Printing, Patient Fields, Specimen Fields, Isolate Fields, Tests, Import, and Export. The main panel is titled 'LIS Parameters' and contains several sections:

- LIS communication enabled**: A checkbox that is checked, highlighted with a red box.
- Port Parameters**: Includes Comm Port (COM1), Data Bits (8), Parity (None), Baud Rate (2400), and Stop Bits (1).
- LIS Options**: Includes Autoload Coded Lists (checked), Unsolicited Upload (checked), Enable LIS Query (unchecked), Send Packed ASTM Frames (checked), Forced Uploads (Test Only), and Physical Protocol (BDMODEM, highlighted with a red box).
- Logical Protocol Parameters**: Includes Use CR and LF to terminate a logical record (checked), Field Delimiter (124), Component Delimiter (94), Repeat Delimiter (92), and Escape Delimiter (38).
- BDMODEM Protocol Parameters**: A section highlighted with a red box containing:
 - Emulate BACTEC 9000 LIS interface: checked
 - ACK: 6
 - SOH: 1
 - Retry Count: 10
 - EOT: 4
 - CAN: 18
 - P Timeout: 10000
 - NAK: 15
 - SYN: 16
 - C Timeout: 15000

At the bottom of the window are buttons for Print Preview, Save, Cancel, Close, and Help.

Saving this information requires that the toolbar be restarted.

When the toolbar is restarted, a new registry key is created that controls how BACTEC test messages are sent from EpiCenter. This registry key must be set to True. The toolbar must again be shut down and restarted after the registry key is changed.



The test messages must be changed for each BACTEC media that will be used. The LIS Code and Auto Upload to LIS columns must be configured as shown below.

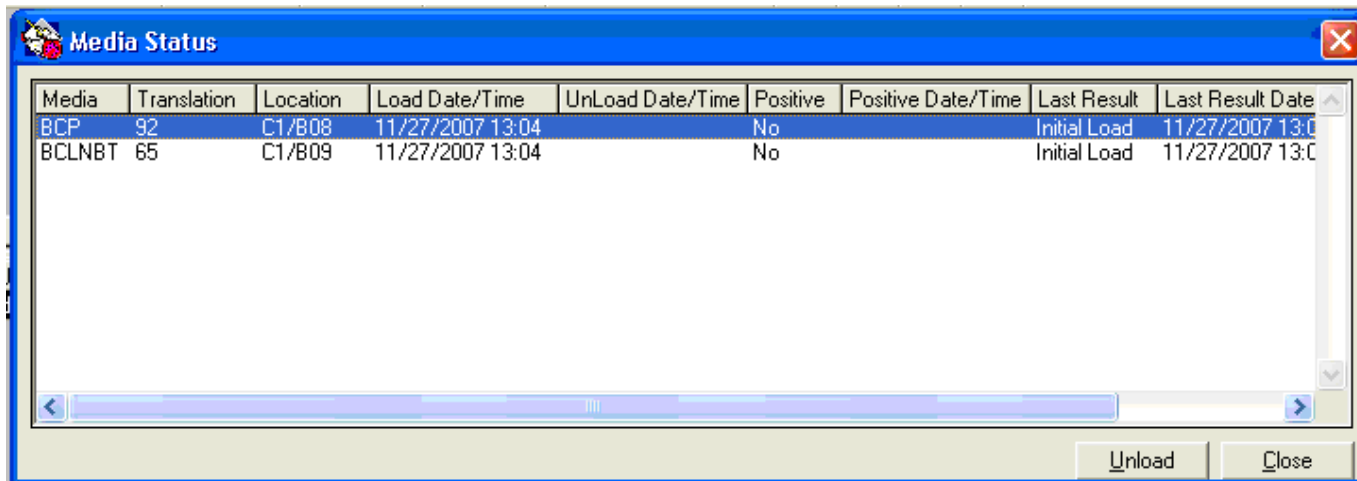
	Test Status	Abbreviation	LIS Code	Test State	Final Result	Contamination	Display Message	Auto Upload to LIS	Chartable	Default Status	Enabled
	Confirmed Positive	*	BACTEC_POS		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Always	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Manual Negative	*	BACTEC_REMOVED		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Always	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Manual Positive	*	BACTEC_POS		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Always	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Negative	*	BACTEC_REMOVED		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Always	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Ongoing	*	BACTEC_NEW		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Always	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Pending	*	Pending		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Never	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Positive	*	BACTEC_POS		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Always	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Removed Ongoing	*	BACTEC_REMOVED		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Always	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
*					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Millennium ANG operation:

Initial order:

When a blood culture is ordered in Millennium, there is an associated Media Status window accessible through an icon on the Millennium toolbar. This window is shown below and the remainder of this document shows the entries in a table.

Table 1.



Media	Translation	Location	Load Date/Time	UnLoad Date/Time	Positive	Positive Date/Time	Last Result	Last Result Date
BCP	92	C1/B08	11/27/2007 13:04		No		Initial Load	11/27/2007 13:04
BCLNBT	65	C1/B09	11/27/2007 13:04		No		Initial Load	11/27/2007 13:04

This information is only viewable by the micro lab staff and is not chartable information. When the blood culture is first ordered and logged into the micro lab, the table is blank except for the Media and Translation columns indicating the types of bottles that are expected to be loaded into BACTEC. The media types are built as a default set that is defined by the account. This would be a typical example where a default set would be an aerobic PLUS bottle and an anaerobic Lytic bottle. If the site receives bottles other than the default set, they must modify the media types listed during the Millennium login step to reflect which bottle types were actually received. This is important for the proper operation of the ANG function since BACTEC reports the media type in the result code and Millennium only accepts the message if the media type codes match. When various operations are performed on BACTEC, test level results are sent to Millennium. Millennium uses these codes to update the media window. The ANG function then determines which results to automatically post based on the fields updated in the media window.

When bottles are placed on the BACTEC, a BACTEC_NEW message is sent from the BACTEC. In EpiCenter, the BACTEC_NEW message will be sent when the status of the BACTEC test is set to Ongoing. When the bottle is placed on the BACTEC and Millennium receives the BACTEC_NEW message, it updates some of the fields in the media window as indicated in Table 2. The date/time is entered as the date/time that Millennium received the BACTEC_NEW message and not the date/time that the bottle was actually placed into the instrument. Typically these two times would be very close with the exception occurring if the LIS were down. Millennium does not use the date/time that the bottles were entered (or message received) in its calculation for reports generated by ANG. It uses the time that the blood cultures were logged into the micro lab in Millennium.

Table 2.

Media	Translation	Location	Load Date/Time	Unload Date/Time	Positive	Positive Date/Time	Last Result	Last Result Date/Time
BCP	92	1/A01	11/14/07 10:00AM		No		Initial bottle entry	11/14/07 10:00AM
BCLNBT	65	1/A02	11/14/07 10:00AM		No		Initial bottle entry	11/14/07 10:00AM

Preliminary Negative results:

The ANG function at the account was set to run at 2:00AM and all time calculations for reports are based on the time stamp in Millennium that the blood culture was logged in to the micro lab. If all bottles listed in the media window have a load date/time and no unload date/time, the culture does not have a positive report entered in Millennium and the time since specimen login is at least 24 hours but less than 48 hours, the ANG function automatically posts a preliminary report of "No Growth at 24 hours." If all bottles listed in the media window have a

load date/time and no unload date/time, the culture does not have a positive report entered in Millennium and the time since specimen login is at least 48 hours but less than 72 hours, the ANG function automatically posts a preliminary report of “No Growth at 48 hours, final result pending.”

Final Negative results:

When the BACTEC bottle remains negative and completes the protocol, the BACTEC sends a BACTEC_NEG message through the interface. The Millennium side of the interface receives the message, but is configured to do nothing with this message. When the negative bottles are removed from the instrument, a BACTEC_REMOVED message is sent and processed to update the media window in Millennium as shown in Table 3. EpiCenter cannot be configured to send separate messages to differentiate the end of protocol from when the bottles are physically removed from the instrument. The closest match is to configure EpiCenter to send the BACTEC_REMOVED message when the status is changed to negative. Millennium updates the unload date/time bottle with the date/time that the message was received and updates the Last Result column to reflect that the bottle has been removed from the instrument even though technically the status change means only that the bottle is negative.

Table 3.

Media	Translation	Location	Load Date/Time	Unload Date/Time	Positive	Positive Date/Time	Last Result	Last Result Date/Time
BCP	92	1/A01	11/14/07 10:00AM	11/19/07 2:00 PM	No		Final bottle unload	11/19/07 2:00 PM
BCLNBT	65	1/A02	11/14/07 10:00AM	11/19/07 2:00 PM	No		Final bottle unload	11/19/07 2:00 PM

The ANG function sends out the final reports after the preliminary reports have been resulted. If all bottles listed in the media window have a load date/time and an unload date/time, and the culture does not have a positive report entered in Millennium, the ANG function automatically posts a final report of “No Growth.” There is no time calculation when the ANG function is run to determine if it is appropriate to send out the final report. A time limitation can be configured, but the account does not utilize it. The only requirement is that the bottle was placed on the instrument at some point and then came off. This way, the lab does not have to modify anything in Millennium if the protocol is changed to something other than the default five days. They can simply change the protocol in the BACTEC and Millennium will automatically final the culture when the unload date/time is populated irrespective of the actual protocol length.

Positive bottles:

When a bottle goes positive, but is still in the instrument, a BACTEC_POS message is sent by BACTEC. This message updates some of the fields in the media window as shown in Table 4, but has no affect on the operation of the ANG function.

Table 4.

Media	Translation	Location	Load Date/Time	Unload Date/Time	Positive	Positive Date/Time	Last Result	Last Result Date/Time
BCP	92	1/A01	11/14/07 10:00AM		Yes	11/15/07 11:00AM	Positive bottle	11/15/07 11:00AM
BCLNBT	65	1/A02	11/14/07 10:00AM		No		Initial bottle entry	11/14/07 10:00AM

When the positive bottle is physically removed from the instrument, a BACTEC_REMOVED message is sent by BACTEC. This message updates the fields in the media window somewhat incorrectly as shown in Table 5. The account did not feel that this inaccurate update was important since if the bottle is negative, it will be re-entered (as described below) or if it is truly positive, the ANG function is no longer used on that culture.

Table 5.

Media	Translation	Location	Load Date/Time	Unload Date/Time	Positive	Positive Date/Time	Last Result	Last Result Date/Time
BCP	92	1/A01	11/14/07 10:00AM	11/15/07 11:30AM	Yes	11/15/07 11:00AM	Positive bottle	11/15/07 11:00AM
BCLNBT	65	1/A02	11/14/07 10:00AM		No		Initial bottle entry	11/14/07 10:00AM

As with the negatives, EpiCenter cannot be configured with different codes to reflect if a bottle is positive in the instrument or positive and removed. The account felt that since sending a BACTEC_REMOVED message was

consistent with a negative bottle, that it would be best to not send this message on a positive bottle. The Positive status in EpiCenter was configured to send the BACTEC_POS message so that the media window will be updated as in Table 4.

False Positive bottles:

When a positive bottle is removed and gram stained with no organisms seen, the bottle is put back into the instrument. The BACTEC sends a BACTEC_REENTERED message, and the media window is updated in Millennium as indicated in Table 6. Note the updated Last Result field.

Table 6.

Media	Translation	Location	Load Date/Time	Unload Date/Time	Positive	Positive Date/Time	Last Result	Last Result Date/Time
BCP	92	1/A01	11/14/07 10:00AM		No		Bottle re-entered	11/15/07 12:00PM
BCLNBT	65	1/A02	11/14/07 10:00AM		No		Initial bottle entry	11/14/07 10:00AM

EpiCenter does not have a re-entered status, so cannot be configured to work exactly as the direct connection. When the bottle is placed back into the instrument, the status in EpiCenter will be changed back to Ongoing and a BACTEC_NEW message will be sent to Millennium. Millennium will update the media window as if the bottle had been placed in the instrument for the first time as indicated in Table 7. Note the changed load date/time field and that the Last Result field does not reflect that the bottle has been re-entered. Since Millennium does not use the actual date/time entered into the media window, it will have no affect on the ANG function.

Table 7.

Media	Translation	Location	Load Date/Time	Unload Date/Time	Positive	Positive Date/Time	Last Result	Last Result Date/Time
BCP	92	1/A01	11/15/07 12:30PM		No		Initial bottle entry	11/15/07 12:30PM
BCLNBT	65	1/A02	11/14/07 10:00AM		No		Initial bottle entry	11/14/07 10:00AM

Other situations:

The BACTEC has an additional message that does not have an equivalent message in EpiCenter. If a bottle is moved due to an error station, BACTEC sends a BACTEC_MOVED message. We could not find past LIS transmissions with this message, but when EpiCenter is attached it is believed that EpiCenter should send a BACTEC_NEW message. Millennium should update the media window in a similar manner to Table 7 except that the station will be updated to the new bottle location.

EpiCenter has an additional status that does not have an equivalent message in BACTEC. If a bottle is removed before reaching a negative or positive status, EpiCenter will give the bottle a Removed Ongoing status. The account felt that this status should be treated the same as a negative bottle and the BACTEC_REMOVED message should be sent since the bottle was probably removed for a legitimate reason and will either remain removed or placed back into the instrument in which case a BACTEC_NEW message would be generated.