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Communication protocol specification for hematology analyzer

1. Introduction of LIS protocol

1.1 Protocol overview

This LIS protocol is based on HL7 Version 2.3.1 and supports bilateral communication.

2. Protocol Definition

2.1 Protocol transfer process

The whole transmission process is divided into three stages: establishing connection, data communication and disconnection.

1) Connection establishment

After the instrument is turned on, it will try to connect the LIS server actively according to the instrument configuration (server IP and port). If the connection is successful, the connection process ends. If the connection is not successful, try reconnecting at intervals.

2) Data communication

When connection is established, the instrument will transfer the information to LIS system after counting, editing, or user chooses to upload. When bilateral LIS communication is started, the instrument will send out a query message for the sample information in the LIS system in the scenario of saving work order and counting.

3) Disconnection

Before the instrument is normally shut down, the connection between the instrument and LIS system will be automatically disconnect. Restarting the port in the Settings will also actively break the connection with the LIS system home and attempt to reconnect with the configuration.

2.2 HL7 Underlying protocol

Since TCP/IP is a byte stream protocol, the message boundary needs to be provided if message confusion is to be avoided. The HL7 protocol only defines the upper layer business message format, and does not provide message boundaries. To confirm message boundaries. In the communication layer, messages are transmitted in the following format:

Message will be sent in the following format:

<SB> ddddd <EB><CR>:

<SB> = Start Block character (1 byte)

| | | | | | | | | | | | | | | | | |
|-----|--|----|--|----|--|------------------|--|-------|--|---|--|-------------|--|--|--|---|
| OBX | | 12 | | NM | | 21482-6^GRAN%^LN | | 30.92 | | % | | 50.00-70.00 | | | | F |
|-----|--|----|--|----|--|------------------|--|-------|--|---|--|-------------|--|--|--|---|

[illegible]

[illegible]

////+f3//v//4AAAH//////////f/////j9/////AAAB//////////4/f////wAAAf//////////+
P3//v//8AAAP//////////f/////j9/////AAAD//////////4/f////wAAA//////////+P3//
v//+AAAf//////////f/////j9/////gAAH//////////4/f////4AAB//////////+f3//v//+A
AA//////////f/////j9/////gAAP//////////4/f////8AAD//////////+P3//v//AAA//
//////////f/////j9/////wAAf//////////4/f////8AAH//////////+P3//v//AAB////////
//////////f/////n9/////4AA//////////4/f////+AAP//////////+P3//v//gAD////////
////f/////j9/////4AB//////////4/f/////AAf//////////+P3//v//wAH//////////f//
//j9/////8AB//////////4/f/////gA//////////+P3//v//4AP//////////f/////j9//
//+AD//////////4/f/////wB//////////+P3//v//8Af//////////f/////n9/////AH
//////////4/f/////4D//////////+P3//v//+A//////////f/////j9/////gP////////
//////////4/f/////8H//////////+f3//v//B//////////f/////j9/////x//////////
/////4/f/////+///////////+P3//v//v//////////f/////n9//////////4/f
//////////+P3//v//////////f/////j9//////////4/f//////////
//////////+P3//v//////////f/////j9//////////5/f//////////
/+P3//v//////////f/////j9//////////4/f//////////+f//////////
//////////j//////////4//////////+P//////////
//////////j//////////4//////////9yDh//////////+P//////////Zkz//////////
//////////y7t//////////4//////////8OCf//////////+f//////////Jh3//////////j//
//////////2bM//////////7//////////8GDh//////////+P//////////Hj8f//////////n//////////
//////////4//////////+P//////////n//////////
//////////5//////////+P//////////g=|||||F

OBX|36|NM|13101^PLT Histogram. Left Line^99MRC||8|||||F

OBX|37|NM|13102^PLT Histogram. Right Line^99MRC||48|||||F

OBX|38|ED|13103^PLT Histogram.

BMP^99MRC| |^Image^BMP^Base64^Qk2yDQAAAAAAD4AAAAoAAAA3QAAAHsAAAABAAEAAAAAAHQNAABwPgAA/
hEAAAIAAAACAAAA//AAAAAAD//////////4//////////+P//////////
//////////3//////////4//////////+P//////////
//////////n//////////58f//jj//8Mcf/8Mcf/8Mcf/8Mcf/8ccf//+PT//+af//nTT//nzT//PTT//Pz
T//zTT//jm//k3//5mm//58m//5mm//58m//8mm//45v//hN//+Zpv/+cJv//Zpv//cJv/8Zpv//+Ob//7zf//mab//ne
b//6ab//7eb//yab//j0//++n//x00//x30//000//030//800//4+f//hz//+eef//+cOf/8eef/8cOf/8eef//+P//////////
//////////j//////////4/////f/////f/////f/////f/////f/////P/////3///3///3///3///3
///3///j///9///9///9///9///9///9///uH4/////f/////f/////f/////f/////f/////7v+fwAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAA+7/j9wAAAAAAAf//////////m/4/cAAAAAAAP//////////+P3AAAAAAD//////////
//////////f//+7/n94AAAAAA///////////i/5/eAAAAAAAf//////////+f3gAAAAAAH//////////
//////////f/////n94AAAAAAL//////////4/eAAAAADP//////////+f3gAAAAD//////////
//////////f/////n98AAAAB//////////4/fAAAAAf//////////+P3wAAAAAP//////////
//////////f/////j98AAAAH//////////4/fAAAAAB//////////+P3wAAAA//////////
////f/////j98AAAAf//////////5/fgAAAP//////////+P34AAAD//////////
f/////j9+AAAB//////////4/fgAAAf//////////+P34AAAP//////////f/////j9+AAAD//////////4/fwAAA//////////+P38AAAf//////////f/////j9/A
AAH//////////5/fwAAB//////////+P38AAAf//////////f/////n9/AAAP
//////////4/f4AAD//////////+P3+AAA//////////f/////j9/gAAf//////////
//////////4/f4AAH//////////+f3/AAB//////////f/////j9/wAA//////////
//////////4/f8AAP//////////+P3/AAD//////////f/////j9/4AB//////////
//////////4/f+AAf//////////+P3/gAH//////////f/////j9/4AB//////////
/4/f/AA//////////+f3/wAP//////////f/////j9/8AD//////////4/f/AB

```

////////////////////////////////+P3/wAf////////////////////////////////f/////j9/8AH////////////////////////////////4/f/gB////////
////////////////////////////////+P3/4Af////////////////////////////////f/////n9/+AP////////////////////////////////4/f/gD////////////////////////////////
////////////////////////////////+P3/4A////////////////////////////////f/////j9/+AP////////////////////////////////4/f/gD////////////////////////////////
////////+P3/4B////////////////////////////////f/////j9/+Af////////////////////////////////4/f/gP////////////////////////////////+P3
/8H////////////////////////////////f/////j9/B////////////////////////////////4/f/wf////////////////////////////////+P3/8H////////
////////////////////////////////f/////n9/B////////////////////////////////4/f/w////////////////////////////////+P3/8P////////////////////////////////
////////f/////j9/j////////////////////////////////4/f/4////////////////////////////////+f3/+P////////////////////////////////f/
////j9/n////////////////////////////////4/f/5////////////////////////////////+P3/v////////////////////////////////f/////n9//
////////////////////////////////4/f////////////////////////////////+P3/v////////////////////////////////f/////j9////////////////////////////////
////////////////////////////////4/f////////////////////////////////+P3/v////////////////////////////////f/////j9////////////////////////////////
////////4/f////////////////////////////////+P3/v////////////////////////////////f/////j9////////////////////////////////5
/f////////////////////////////////+P3/v////////////////////////////////f/////j9////////////////////////////////4/f////////
////////////////////////////////+f////////////////////////////////j////////////////////////////////4////////////////////////////////
////////+P////////////////////////////////j////////////////////////////////4////////////////////////////////9yDh////////////////////////////////
//+P////////////////////////////////Zkz////////////////////////////////y7t////////////////////////////////4////////////////////////////////8OCf////////////////////////////////+f/////
////////Jh3////////////////////////////////j////////////////////////////////2bM////////////////////////////////7////////////////////////////////8GDh////////////////////////////////+P////////////////////////////////
//Hj8f////////////////////////////////n////////////////////////////////4////////////////////////////////+P////////////////////////////////
////////n////////////////////////////////5////////////////////////////////+P////////////////////////////////
//g=|||||F

```

LIS system reply message example:

```
MSH|^~&|Z3|Zybio|||20180514144801||ACK^R01|2018481414050147670|P|2.3.1|||||UNICODE
```

```
MSA|AA|1
```

2.4 HL7 Basic Syntax

Each HL7 message consists of segments that end with <CR> (that is, <0x0D>). Messages are transmitted in UTF-8 format.

Each segment is composed of a three-character segment name and a fixed number of domains. Domains are composed of components and subcomponents, and the separator of the constituent units are defined in the MSH segment of each message.

such as:

```
MSH|^~&|Z3|Zybio|||20180514144801||ORU^R01|2018481414050147670|P|2.3.1|||||UNICODE
```

After MSH, there are 5 kinds of characters are used to separate domains, components and subcomponents. HL7 protocol use below standard characters:

- | separator of domains
- ^ separator of components
- & separator of subcomponents
- ~ Repetition separator

\ Escape character

First domain of MSH includes different kinds of separators. Some other following domains may be empty, because the production does not use all of the domains. Here are some definitions of domains:

Domain 9: includes message type and event (ORU, R01)

Domain 10: includes a unique message ID

Domain 11: includes processing ID

Domain 12: define HL7 message version (2.3.1)

For any message, the order of the segments after the MSH segment is specified, and the following sections describe the order in detail, using these syntax constructs to indicate whether the segment is optional or repeated:

[] indicates that the paragraph inside is optional.

{ } means that the paragraphs can be repeated zero or one or more times.

Diagnostic information, user-defined gender and other string data, if the above definition of the segmentation character. When encoding, the separator in the original string needs to be escaped as an escape character sequence and restored at decoding time.

| Escape character sequences | The original character |
|----------------------------|--|
| \R\ | Repetition separator |
| \S\ | Component separator |
| \T\ | Subcomponent separator |
| \F\ | Field separator |
| \E\ | Escape separator |
| \.br\ | <CR>, the end of the message character |

3 Message segment definition

3.1 MSH

MSH (Message Header) is the first message segment of HL7, include basic information of HL7, like value of message separator, type of message, the method of messages encoding and so on.

Message example:

```
MSH|^~&|Z3|Zybio|||20180514144801||ORU^R01|2018481414050147670|P|2.3.1|||UNICODE
```

MSH Message segment definition refer to table 1.

| NO. | Name | Type | limitation of length (<=) | Meaning | Example |
|-----|----------------------|------|---------------------------|--|----------------|
| 1 | Field Separator | ST | 1 | Contains the first field separator after the message segment name to specify the value of the field separator for the rest of the message. | |
| 2 | Encoding Characters | ST | 4 | Contains component separators, repeat separators, escape separators, and subcomponent separators. | ^~\& |
| 3 | Sending application | EI | 180 | The sender application. If the host sends a message, its value is "Z3". | Z3 |
| 4 | Sending Facility | EI | 180 | Sending end devices. Value is "Zybio". | Zybio |
| 7 | Date/Time Of Message | TS | 26 | Message creation time equals to system time (Form like YYYY[MM[DD[HH[MM[SS]]]]]) | 20140927104252 |
| 9 | Message Type | CM | 7 | Message types, forms such as "message type ^ event type". | ORU^R01 |
| 10 | Message Control ID | ST | 20 | Message control ID that uniquely identifies a message. | 1 |
| 11 | Processing ID | PT | 3 | Message processing ID. Values include: "P" : sample information "Q": information quality count results. | P |
| 12 | Version ID | VID | 60 | HL7 version, value "2.3.1". | 2.3.1 |

Table 1

3.1.1 MSH-09

Definition of the 9th message segment in MSH:

| Value | Meaning | Remarks |
|---------|---|---|
| ORU^R01 | Counting results and quality control results uploading. | When it is the quality control result, the 11th message segment value of MSH is Q |
| ACK^R01 | Confirm received ORU ^ R01 message. ACK Acknowledgment description MSH Message Header MSA Message Assurance, describe whether receive successfully or not. | |

| | | |
|----------|--|--|
| ORM^O01 | | |
| ORR^ O02 | | |

3.2 MSA

MSA - message acknowledgment segment:

| NO. | Name | Length | Meaning |
|-----|-----------------------------|--------|--|
| 1 | Acknowledgment Code | 2 | Verify the code, and AA indicates acceptance; AE indicates error; AR indicates reject. |
| 2 | Message Control ID | 20 | Message control ID, same as the sender's MSH-10 |
| 3 | Text Message | 80 | Text message, a text description of an event when an error or rejection occurs. Corresponds to 6th message segment. Can be used to write error logs. |
| 4 | Expected Sequence Number | 15 | Empty, reserved. Expected serial number |
| 5 | Delayed Acknowledgment Type | 1 | Empty, reserved. Type of delayed confirmation |
| 6 | Error Condition | 100 | Error condition (status code) |
| 10 | Message Control ID | ST | 20 |
| 11 | Processing ID | PT | 3 |
| 12 | Version ID | VID | 60 |

3.2.1 MSA-6

Value of message segment MSA-6 refer to following table:

| Status code | Status Text (MSA-3) | Description/Notes |
|---------------------------|----------------------------|--|
| Success status code: AA | | |
| 0 | Message accepted | Succeed |
| Error status code: AE | | |
| 100 | Segment sequence error | The middle segments of the message are not in the correct order, or the necessary segments are lost. |
| 101 | Required field missing | Missing necessary segment |
| 102 | Data type error | An error in the data type of a segment, such as sending characters for numeric information |
| 103 | Table value not found | Table value not found |
| Rejection status code: AR | | |
| 200 | Unsupported message type | Message types are not supported |
| 201 | Unsupported event code | Event code is not supported |
| 202 | Unsupported processing id | Processing ID is not supported |
| 203 | Unsupported version id | Version ID is not supported |
| 204 | Unknown key identifier | Unknown keyword identification, such as transmitting a nonexistent patient information |
| 205 | Duplicate key identifier | Duplicate keywords already exist |
| 206 | Application record locked | Transactions cannot be executed at the application storage level, such as a database being locked |
| 207 | Application internal error | Unknown internal application error |

3.3 PID

PID (Patient Identification) The message segment contains the patient's basic information

Message sample:

PID|1||120112001^^^^MR||^Tom||20070102|Male

| Segment No. | Name | Type | Length | Meaning | Example |
|-------------|--------------------|------|--------|--|-----------|
| 1 | Set ID -PID | SI | 4 | Serial number, used to identify different PID news section of a message. | 1 |
| 3 | Patient Identifier | CX | 20 | Act as patient ID number in the sample test result message like "patient ID^^^^MR". In | 120112001 |

| | | | | | |
|---|--------------------|-----|----|--|------------|
| | List | | | the quality control message, used to represent the quality control batch number. | |
| 5 | Patient Name | XPN | 48 | Patient name(First name and Last name) like " LastName^FirstName". | Vera^Jones |
| 7 | Date/Time of Birth | TS | 26 | In the sample result message, used as the time of birth. Like "YYYY[MM[DD[HH[MM[SS]]]]]" In the quality control information, used as the validity of quality control. | 20070102 |
| 8 | Sex | IS | 1 | Patient gender, string. | Male |

3.4 PV1

PV1 (Patient Visit) contains patient information

Message sample:

PV1|1| inpatient | medical ^1^2|||||||||||| self-paying

| Segment NO. | Name | Type | Length | Meaning | Example |
|-------------|---------------------------|------|--------|---|-------------|
| 1 | Set ID -PV1 | SI | 4 | Serial number, used to identify the different PV1 news section on the news. | 1 |
| 2 | Patient Class | IS | 1 | Patient type, string, contents unlimited. | Inpatient |
| 3 | Assigned Patient Location | PL | 80 | The patient position information, like "department ^ room ^ bed. | Medical |
| 20 | Financial Class | FC | 50 | Cost, string, content unlimited. | Self-paying |

3.5 OBR

OBR (Observation Request) This message segment mainly contains the report information:

OBR|1||JL-5-szwc-02|01001^Automated Count^99MRC||20180401111230|20180401211230||| Doctor
Vera|||20180401211231|||||||HM|||||admin

| Segment NO. | Name | Type | Length | Meaning | Example |
|-------------|--------------------------------------|------|--------|--|-----------------------------|
| 1 | Set ID - OBR | SI | 10 | Serial number, used to confirm different OBR message segment. | 1 |
| 2 | Placer Order Number | EI | 22 | In the work order query response message that ORC ^ O02 number used as a sample. | |
| 3 | Filler Order Number + | EI | 22 | In the sample test result message, as the sample number. In the quality control message, as the file number. | JL-5-szwc-02 |
| 4 | Universal Service ID | CE | 200 | Generic service identifier that identifies different count result types. See configuration file for specific values. | 01001^Automated Count^99MRC |
| 6 | Requested Date/time | TS | 26 | Application time. Used to represent the sampling time. | 20180401111230 |
| 7 | Observation Date/Time | TS | 26 | Examination time | 20180401211230 |
| 10 | Collector Identifier * | XC N | 60 | Sample collector. This is used to represent the deliverer. | Doctor Vera |
| 13 | Relevant Clinical Info. | ST | 300 | Relevant clinical information. Can be used to represent clinical diagnostic information in patient information. | |
| 14 | Specimen Received Date/Time * | TS | 26 | Sample receipt time. Used to indicate the time of submission. | |
| 15 | Specimen Source * | CM | 300 | Sample source. An HL7 message values are: "BLDV" - venous blood "BLDC" -peripheral blood | |
| 22 | Results Rpt/Status Chng -Date/Time + | TS | 26 | Results report/status change - time. Use as audit time. | 20180401211231 |
| 24 | Diagnostic Serv Sect ID | ID | 10 | The diagnostic part ID is "HM", meaning Hematology. | HM |

| | | | | | |
|----|------------------|-----|-----|--|-------|
| 28 | Result Copies To | XCN | 200 | Results primary interpreters. In the sample message, used to represent the examiner. In a quality count message, used to represent the operator. | admin |
|----|------------------|-----|-----|--|-------|

3.5.1 OBR-4

| ID | Name | Meaning | EncodeSys |
|-------|-----------------|-----------------|-----------|
| 01001 | Automated Count | Counting result | 99MRC |
| 01002 | LJ QCR | L-J QC results | 99MRC |
| 01003 | XB QCR | X-B QC results | 99MRC |

3.6 OBX

OBX (Observation/Result) This message segment mainly contains the parameter information of each test result.

OBX|7|NM|731-0^LYM#^LN||4.14|10^9/L|1.10-3.20||||F

| Segment NO. | Name | Type | Length | Meaning | Example |
|-------------|------------------------|------|--------|--|---------------|
| 1 | Set ID-OBX | SI | 10 | Serial number, and identifies the different OBX news on the news section. | 7 |
| 2 | Value Type | ID | 3 | Inspection results of the data type, value IS "ST", "NM", "ED" and "IS" and so on. | NM |
| 3 | Observation Identifier | CE | 590 | Verify item identification. Format: "ID^Name^EncodeSys", ID is the verification project identification, Name is the verification project description information, and EncodeSys is the verification project coding system. Coding values of each item are in configuration file. Note: ID and EncodeSys are used to uniquely determine a test parameter, while Name is mainly descriptive and cannot be used as an identifier. | 731-0^LYM#^LN |

| | | | | | |
|----|---------------------------|----|--------|---|-----------|
| 5 | Observation Value | * | 6553 5 | Verify the result data, which can be Numbers, strings, enumeration values, binary data, and so on.(The binary data such as histogram and scatter diagram are transformed by Base64 encoding) | 4.14 |
| 6 | Units | CE | 90 | Inspect the project unit adopt ISO standard. | 10*9/L |
| 7 | References Range | ST | 90 | The test results are in the following three formats: "Reference range lower limit - reference range upper limit" "< reference range upper limit" "> reference range lower limit" | 1.10-3.20 |
| 8 | Abnormal Flags | ID | 5 | Test result sign, including: "N": normal "A": abnormal "H": the result is above the upper limit of the reference range "L": results below the lower limit of reference range Note: This Field is likely to have abnormal marks or high and low alarm marks exist at the same time, this time more than with "~" connections between symbol, such as "H ~ A". | |
| 11 | Observation Result Status | ID | 1 | Check the status of the results. The value is "F", which represents the final result. | |

3.6.1 OBX Business field description

Here are some key data items are explained:

| Data item | Type (OBX-2) | Code (ID) | Name | EncodeSys | Segment (OBX-3) |
|--------------|--------------|-----------|------------|-----------|-------------------------|
| Sample model | IS | 03001 | Take Mode | 99MRC | 03001^Take Mode^99MRC |
| Blood Mode | IS | 03002 | Blood Mode | 99MRC | 03002^Blood Mod e^99MRC |
| Test Mode | IS | 03003 | Test Mode | 99MRC | 03003^Test Mode ^99MRC |
| Age | NM | 31525-0 | Age | LN | 31525-0^Age^LN |

3.7 ORC

ORC (Common Order) this message segments mainly contain general information with Order.

Message example:

ORC|RF||SampleID||IP

This Segment definition is shown in the following table:

| NO. | Segment name | Data type | Maximum recommended length | Description | Example |
|-----|---------------------|-----------|----------------------------|---|-----------|
| 1 | OrderControl | ID | 2 | Order control word ORM The message is "RF", meaning "refill order request". ORR The message is "AF", meaning "order refill confirmation". | RF |
| 2 | Placer Order Number | EI | 22 | Order Sponsor number。 ORM The value in the message is empty. ORR The value in the message is the sample number. | |
| 3 | Filler OrderNum | EI | 22 | Order Recipient number. ORM The value in the message is the sample number ORR The value in the message is empty. | Sample ID |

| | | | | | |
|---|--------------|----|---|--|----|
| 5 | Order Status | ID | 2 | Order status The value is fixed as "IP" in the communication ORM message of the work Order information query, which means "Order is processing, but the result has not been obtained". ORR message null values. | IP |
|---|--------------|----|---|--|----|

OBX|21|NM|777-3^PLT^LN||364|10^9/L|125.00-350.00|||F

OBX|22|NM|33623-1^MPV^LN||12.62|fL|7.00-11.00|||F

OBX|23|NM|33207-3^PDW^LN||24.38||6.50-12.00|||F

OBX|24|NM|12003^PCT^99MRC||0.46|%|0.11-0.28|||F

OBX|25|NM|35167-7^P-LCC^LN||209.98|10^9/L|30.00-90.00|||F

OBX|26|NM|49386-7^P-LCR^LN||57.57|%|11.00-45.00|||F

OBX|27|NM|72426-1^CRP^LN||0.00|mg/L|0.0-10|||F

OBX|28|NM|12008^Hs-CRP^99MRC||10.00|mg/L|0.0-10.0|||F

OBX|29|NM|13001^WBC Histogram. Left Line^99MRC||20|||F

OBX|30|NM|13002^WBC Histogram. Right Line^99MRC||50|||F

OBX|31|ED|13003^WBC Histogram.
BMP^99MRC||^Image^BMP^Base64^*****WBC Histogram bitmap
data (BMP bitmap BASE64 format) *****|||F

OBX|32|NM|13004^WBC Histogram. Middle Line^99MRC||70|||F

OBX|33|NM|13051^RBC Histogram. Left Line^99MRC||23|||F

OBX|34|NM|13052^RBC Histogram. Right Line^99MRC||230|||F

OBX|35|ED|13053^RBC Histogram.
BMP^99MRC||^Image^BMP^Base64^*****RBC Histogram bitmap data
(BMP bitmap BASE64 format) *****|||F

OBX|36|NM|13101^PLT Histogram. Left Line^99MRC||8|||F

OBX|37|NM|13102^PLT Histogram. Right Line^99MRC||48|||F

OBX|38|ED|13103^PLT Histogram.
BMP^99MRC||^Image^BMP^Base64^*****PLT Histogram bitmap data
(BMP bitmap BASE64 format) *****|||F

2) Sample reply message

For each sample result received, a sample response message needs to be responded. The sample reply message contains two message segments: MSH and MSA. Correct reply message need to pay attention to two points: MSH-9 fields need to fill in the content of the ACK ^ R01, indicates that the message of reply message type is a sample. The value of the MSA-2 field is the same as that of the MSH-10 field receiving the count result, indicating which count result the reply message corresponds to has been issued, and in this case, the value of the MSA-2 field is 2018481414050147670.

```
MSH|^~&|Z3|Zybio|||20180514144801||ACK^R01|2018481414050147670|
P|2.3.1|||||UNICODE
MSA|AA|2018481414050147670
```

3.8.2 Sample quality control messages

1) Quality control request message

The content form of quality control message is different from that of sample count result message: the value of MSH-11 of quality control message is Q, representing that message type is quality control data; A quality control message corresponds to a quality control point of the system software, and may contain multiple count results. For example, an L-J quality control message may contain one count result, while an X-R quality control message may contain two count results and average count result.

The quality control message is composed of a MSH message header and multiple count results. Each count result starts with PID, OBR message segment containing sample information, followed by multiple OBX message segments for carrying parameter results and other information. The OBR-4 field of each count result represents the type of the count result, whether it is the X-R count result, the average value of the X-R count result, or an L-J count result. See the appendix message encoding definition for the specific value.

L - J quality control:

```
MSH|^~&|Z3|Zybio|||20181030120008||ORU^R01|2018103012000847670|Q|
2.3.1|||||UNICODE
PID|1|^LJ^MR|^|20181030|0
OBR|1|1|01003^LJ
QCR^99MRC||20181030115259|00000000000000000000|HM|00000000
OBX|1|IS|03001^Take Mode^99MRC||O|||||F
OBX|2|IS|03002^Blood Mode^99MRC||W|||||F
OBX|3|IS|03003^Test Mode^99MRC||O|||||F
OBX|4|IS|03004^Qc Level^99MRC||M|||||F
OBX|5|NM|6790-2^WBC^LN||3.70|10^9/L||||F
OBX|6|NM|731-0^LYM#^LN||1.61|10^9/L||||F
OBX|7|NM|33154-7^MID#^LN||0.31|10^9/L||||F
```

OBX|8|NM|19023-1^GRAN#^LN||1.78|10^9/L||||F

OBX|9|NM|736-9^LYM%^LN||43.6|%||||F

OBX|10|NM|33155-4^MID%^LN||8.4|%||||F

OBX|11|NM|21482-6^GRAN%^LN||48.0|%||||F

OBX|12|NM|789-8^RBC^LN||3.87|10^12/L||||F

OBX|13|NM|718-7^HGB^LN||107|g/L||||F

OBX|14|NM|4544-3^HCT^LN||63.2|%||||F

OBX|15|NM|787-2^MCV^LN||163.2|fL||||F

OBX|16|NM|785-6^MCH^LN||27.7|pg||||F

OBX|17|NM|786-4^MCHC^LN||170|g/L||||F

OBX|18|NM|788-0^RDW-CV^LN||16.5|%||||F

OBX|19|NM|22000-5^RDW-SD^LN||92.1|fL||||F

OBX|20|NM|777-3^PLT^LN||296|10^9/L||||F

OBX|21|NM|33623-1^MPV^LN||12.7|fL||||F

OBX|22|NM|33207-3^PDW^LN||17.6|fL||||F

OBX|23|NM|12003^PCT^99MRC||0.378|%||||F

OBX|24|NM|35167-7^P-LCC^LN||152|10^9/L||||F

OBX|25|NM|49386-7^P-LCR^LN||51.3|%||||F

X - B quality control

MSH|^~&|Z3|Zybio|||20181030120038||ORU^R01|20181030120038118627|Q
|2.3.1|||||UNICODE

PID|1||^MR||||

OBR|1||XB QCR|01005^XB

QCR^99MRC||20181030115847|||||||||||||HM|||||

OBX|1|NM|787-2^MCV^LN||100.0|fL||||F

OBX|2|NM|785-6^MCH^LN||50.0|pg||||F

OBX|3|NM|786-4^MCHC^LN||160|g/L||||F

2) QC response message

There is only one difference between a qc reply message

and a counter result reply message: MSH-11 segment is Q.

The following one is to cancel ACK of L-J quality control.

```
MSH|^~&|Z3|Zybio|||20181030120008||ACK^R01|2018103012000847670|Q|  
2.3.1|||||UNICODE  
MSA|AA|2018103012000847670
```

Appendix: message encoding definition

4.1 OBR- data type

In HL7 protocol, the OBR - 4 (Universal Service ID) field is used to identify the type of test results, such as microscopic examination of the sample test results, quality count results and as a result, said format for "ID ^ Name ^ EncodeSys". The following table lists all encoding values for this field.

| D | Name | Meaning | EncodeSys |
|-------|-----------------|----------------------------------|-----------|
| 01001 | Automated Count | counting result | 99MRC |
| 01002 | Manual Count | examined microscopically | 99MRC |
| 01003 | LJ QCR | LJ Quality control count results | 99MRC |
| 01004 | X QCR | X Quality control count results | 99MRC |
| 01005 | XB QCR | XB Quality control count results | 99MRC |

4.2 OBX- Data type

Each OBX message segment contains information about a validation parameter or other data item, consisting of the following fields:

Like OBX|6|NM|6790-2^WBC^LN||13.91|10^9/L|3.50-9.50||||F

| NO. | Value | Meaning |
|-----|-------|---|
| 2 | NM | OBX-2 Specifies the HL7 data type of the data |

| | | |
|----------|---------------|--|
| | | item to be carried |
| 3 | 6790-2^WBC^LN | OBX-3 (Observation Identifier) Is the identity of a data item, expressed as "ID^Name^EncodeSys" |
| 5 | 13. 91 | OBX-5 Contains data item value; |
| 6 | 10^9/L | OBX-6 Contains parameter item units, represented by ISO standard units |
| 7 | 3.50-9.50 | Range of inspection results and forms such as: "reference range lower limit - reference range cap", or "< reference range limit", or "> reference range lower limit. |

The data item type and coding system are as follows:

| Data item | HL7 Type (OBX-2) | Code (ID) | (Name) | EncodeSys | OBX-3 Segment example |
|------------------------------|------------------|-----------|------------|-----------|-------------------------|
| Other data items | | | | | |
| Take Mode | IS | 03001 | Take Mode | 99MRC | 03001^Take Mode^99MRC |
| Blood Mode | IS | 03002 | Blood Mode | 99MRC | 03002^Blood Mod e^99MRC |
| Test Mode | IS | 03003 | Test Mode | 99MRC | 03003^Test Mode ^99MRC |
| Age | NM | 31525-0 | Age | LN | 31525-0^Age^LN |
| Ref Group | IS | 04001 | Ref Group | 99MRC | 04001^Ref Group ^99MRC |
| Remark | IS | 09001 | Remark | 99MRC | 09001^Remark^99 MRC |
| Qc Level | IS | 03004 | Qc Level | 99MRC | 03004^Qc Level^99MRC |
| Test result data item | | | | | |
| Data item | HL7 Type (OBX-2) | Code (ID) | Name | EncodeSys | OBX-3 Segment example |
| WBC | NM | 6790-2 | WBC | LN | 6790-2^WBC^LN |
| BAS# | NM | 704-7 | Bas# | LN | 704-7^BAS#^LN |
| BAS% | NM | 706-2 | Bas% | LN | 706-2^BAS%^LN |
| NEU# | NM | 751-8 | Neu# | LN | 751-8^NEU#^LN |
| NEU% | NM | 770-8 | Neu% | LN | 770-8^NEU%^LN |

| | | | | | |
|-----------|------------------|-----------|--------|-----------|-----------------------|
| EOS# | NM | 711-2 | Eos# | LN | 711-2^EOS#^LN |
| EOS% | NM | 713-8 | Eos% | LN | 713-8^EOS%^LN |
| LYM# | NM | 731-0 | Lym# | LN | 731-0^LYM#^LN |
| LYM% | NM | 736-9 | Lym% | LN | 736-9^LYM%^LN |
| MON# | NM | 742-7 | Mon# | LN | 742-7^MON#^LN |
| MON% | NM | 5905-5 | Mon% | LN | 5905-5^MON%^LN |
| ALY# | NM | 26477-0 | *Aly# | LN | 26477-0^*ALY#^L N |
| ALY% | NM | 13046-8 | *Aly% | LN | 13046-8^*ALY%^L N |
| LIC# | NM | 11001 | *Lic# | 99MRC | 11001^*LIC#^99M RC |
| LIC% | NM | 11002 | *Lic% | 99MRC | 11002^*LIC%^99M RC |
| RBC | NM | 789-8 | RBC | LN | 789-8^RBC^LN |
| HGB | NM | 718-7 | HGB | LN | 718-7^HGB^LN |
| MCV | NM | 787-2 | MCV | LN | 787-2^MCV^LN |
| MCH | NM | 785-6 | MCH | LN | 785-6^MCH^LN |
| MCHC | NM | 786-4 | MCHC | LN | 786-4^MCHC^LN |
| RDW-CV | NM | 788-0 | RDW-CV | LN | 788-0^RDW-CV^LN |
| RDW-SD | NM | 22000-5 | RDW-SD | LN | 22000-5^RDW-SD^ LN |
| HCT | NM | 4544-3 | HCT | LN | 4544-3^HCT^LN |
| PLT | NM | 777-3 | PLT | LN | 777-3^PLT^LN |
| MPV | NM | 33623-1 | MPV | LN | 33623-1^MPV^LN |
| Data Item | HL7 Type (OBX-2) | Code (ID) | Name | EncodeSys | OBX-3 Segment example |
| PDW | NM | 33207-3 | PDW | LN | 33207-3^PDW^LN |
| PCT | NM | 12003 | PCT | 99MRC | 12003^PCT^99MRC |
| PLCR | NM | 49386-7 | P-LCR | LN | 49386-7^P-LCR^LN |
| PLCC | NM | 35167-7 | P-LCC | LN | 35167-7^P-LCC^LN |
| GRAN-X | NM | 12004 | GRAN-X | 99MRC | 12004^GRAN-X^99MRC |
| GRAN-Y | NM | 12005 | GRAN-Y | 99MRC | 12005^GRAN-Y^99MRC |
| GRAN-Z | NM | 12006 | GRAN-Z | 99MRC | 12006^GRAN-Z^99MRC |
| W-MCV | NM | 12007 | W-MCV | 99MRC | 12007^W-MCV^99MRC |

| | | | | | |
|--|---------------------|--------------|---------------------------|-----------|-----------------------------------|
| CRP | NM | 72426-1 | CRP | LN | 71426-1^CRP^LN |
| Hs-CRP | NM | 12008 | Hs-CRP | 99MRC | 12008^Hs-CRP^99MRC |
| GRAN# | NM | 19023-1 | GRAN# | LN | 19023-1^GRAN#^LN |
| GRAN % | NM | 21482-6 | GRAN % | LN | 21482-6^GRAN%^LN |
| MID# | NM | 33154-7 | MID# | LN | 33154-7^MID#^LN |
| MID% | NM | 33155-4 | MID% | LN | 33155-4^MID%^LN |
| | | | | | |
| Microscopic examination results and related data | | | | | |
| Blood Type | ST | 882-1 | Blood Type | LN | 882-1^Blood Typ e^LN |
| ESR | NM | 30341-2 | ESR | LN | 30341-2^ESR^LN |
| WBC Morphology | ST | 11156-7 | WBC Morphology | LN | 11156-7^WBC Morphology^LN |
| RBC Morphology | ST | 6742-1 | RBC Morphology | LN | 6742-1^RBC Morphology^LN |
| PLT Morphology | ST | 11125-2 | PLT Morphology | LN | 11125-2^PLT Morphology^LN |
| Segment Neut | NM | 769-0 | Neuts Seg%. Manual | LN | 769-0^Neuts Seg%. Manual^LN |
| Band For m Neut | NM | 764-1 | Neuts Band%. Manual | LN | 764-1^Neuts Band%. Manual^LN |
| Lymphocytes | NM | 737-7 | Lymphocytes%. Manual | LN | 737-7^Lymphocyt es%. Manual^LN |
| Data | HL7 Type (OBX-2) | Code (ID) | Name | EncodeSys | OBX-3 Segment Example |
| Monocyte | NM | 744-3 | Monocytes%. Manual | LN | 744-3^Monocytes%. Manual^LN |
| Eosinophils | NM | 714-6 | Eosinophils %. Manual | LN | 714-6^Eosinophi ls%. Manual^LN |
| Basophils | | | Basophils%. Manual | | 707-0^Basophils %. Manual^LN |

| | | | | | |
|--------------------|-----------------|-----------|-------------------------------|-----------|---|
| | NM | 707-0 | | LN | |
| AbnLymph | NM | 29261-5 | Abnormal Lymphs%. Manual | LN | 29261-5^Abnormal Lymphs%. Manual^LN |
| Myeloblast | NM | 747-6 | Myeloblasts . Manual | LN | 747-6^Myeloblasts%. Manual^LN |
| Promyelocyte | NM | 783-1 | Promyelocytes. Manual | LN | 783-1^Promyelocytes%. Manual^LN |
| Myelocyte | NM | 749-2 | Myelocytes%. Manual | LN | 749-2^Myelocytes%. Manual^LN |
| MetaMyelocyte | NM | 740-1 | Metamyelocyte%. Manual | LN | 740-1^Metamyelocyte%. Manual^LN |
| Prolymphocytes | NM | 6746-2 | Prolymphocytes%. Manual | LN | 6746-2^Prolymphocytes%. Manual^LN |
| Promonocytes | NM | 13599-6 | Promonocytes%. Manual | LN | 13599-6^Promonocytes%. Manual^LN |
| Reticulocyte | NM | 31112-6 | Reticulocytes%. Manual | LN | 31112-6^Reticulocytes%. Manual^LN |
| NRBCS | NM | 18309-5 | NRBCs%. Manual | LN | 18309-5^NRBCs%. Manual^LN |
| UndefinedCells | NM | 21001 | Undefined Cells%. Manual | 99MRC | 21001^Undefined Cells%. Manual^99MRC |
| OtherAbnormalCells | NM | 21002 | Other Abnormal Cells%. Manual | 99MRC | 21002^Other Abnormal Cells%. Manual^99MRC |
| Plasmacyte | NM | 21003 | Plasmacyte%. Manual | 99MRC | 21003^Plasmacyte%. Manual ^99MRC |
| Data | HL7 Type(OBX-2) | Code (ID) | Name | EncodeSys | OBX-3 Segment Example |

| | | | | | |
|---|----|-------|--|-------|---|
| Eosinophilic myelocyte | NM | 21004 | Eosinophilic myelocyte% . Manual | 99MRC | 21004^Eosinophilic myelocyte%. Manual ^99MRC |
| Basophilic myelocyte | NM | 21005 | Basophilic myelocyte% . Manual | 99MRC | 21005^Basophilic myelocyte%. Manual ^99MRC |
| Eosinophilic metamyelocyte | NM | 21006 | Eosinophilic metamyelocyte % . Manual | 99MRC | 21006^Eosinophilic metamyelocyte%. Manual ^99MRC |
| Basophilic metamyelocyte | NM | 21007 | Basophilic metamyelocyte % . Manual | 99MRC | 21007^Basophilic metamyelocyte%. Manual ^99MRC |
| Intermediate data of test results (WBC, RBC, PLTHistogram and scatter plot data, etc) | | | | | |
| WBC Histogram. Left Line | NM | 13001 | WBC Histogram. Left Line | 99MRC | 13001^WBC Histogram. Left Line^99MRC |
| WBC Histogram. Right Line | NM | 13002 | WBC Histogram. Right Line | 99MRC | 13002^WBC Histogram. Right Line^99MRC |
| WBC Histogram. BMP | ED | 13003 | WBC Histogram. BMP | 99MRC | 13003^WBC Histogram. BMP^99MRC |
| WBC Histogram. Middle Line | NM | 13004 | WBC Histogram. Middle Line | 99MRC | 13004^WBC Histogram. Middle Line^99MRC |
| RBC Histogram. Left Line | NM | 13051 | RBC Histogram. Left Line | 99MRC | 13051^RBC Histogram. Left Line^99MRC |
| RBC Histogram. Right Line | NM | 13052 | RBC Histogram. Right Line | 99MRC | 13052^RBC Histogram. Right Line^99MRC |
| RBC Histogram. BMP | ED | 13053 | RBC Histogram. BMP | 99MRC | 13053^RBC Histogram. BMP^99MRC |
| PLT Histogram. Left Line | NM | 13101 | PLT Histogram. Left Line | 99MRC | 13101^PLT Histogram. Left Line^99MRC |

| | | | | | |
|---------------------------------------|---------------------|--------------|---------------------------------------|-----------|---|
| PLT Histogram. Right Line | NM | 13102 | PLT Histogram. Right Line | 99MRC | 13102^PLT Histogram. Right Line^99MRC |
| PLT Histogram. BMP | ED | 13103 | PLT Histogram. BMP | 99MRC | 13103^PLT Histogram. BMP^99MRC |
| WBC DIFF Scattergram. LS-MS BMP | ED | 13151 | WBC DIFF Scattergram. LS-MS BMP | 99MRC | 13151^WBC DIFF Scattergram. LS-MS BMP ^99MRC |
| Data | HL7 Type (OBX-2) | Code (ID) | Name | EncodeSys | OBX-3 Segment example |
| WBC DIFF Scattergram. LS-HS BMP | ED | 13152 | WBC DIFF Scattergram. LS-HS BMP | 99MRC | 13152^ WBC DIFF Scattergram. LS-HS BMP ^99MRC |
| WBC DIFF Scattergram. HS-MS BMP | ED | 13153 | WBC DIFF Scattergram. HS-MS BMP | 99MRC | 13153^ WBC DIFF Scattergram. HS-MS BMP ^99MRC |
| BASO Scattergram. LS-MS BMP | ED | 13154 | BASO Scattergram. LS-MS BMP | 99MRC | 13154^BASO Scattergram. LS-MS BMP ^99MRC |
| BASO Scattergram. LS-HS BMP | ED | 13155 | BASO Scattergram. LS-HS BMP | 99MRC | 13155^BASO Scattergram. LS-HS BMP ^99MRC |
| BASO Scattergram. HS-MS BMP | ED | 13156 | BASO Scattergram. HS-MS BMP | 99MRC | 13156^BASO Scattergram. HS-MS BMP ^99MRC |
| | | | | | |
| RET Scattergram. LS-MS BMP | ED | 13157 | RET Scattergram. LS-MS BMP | 99MRC | 13157^RET Scattergram. LS-MS BMP^99MRC |
| RET Scattergram. LS-HS BMP | ED | 13158 | RET Scattergram. LS-HS BMP | 99MRC | 13158^RET Scattergram. LS-HS BMP^99MRC |
| RET Scattergram. HS-MS BMP | ED | 13159 | RET Scattergram. HS-MS BMP | 99MRC | 13159^RET Scattergram. HS-MS BMP^99MRC |

| | | | | | |
|--------------------------------------|---------------------|--------------|--|-----------|--|
| PLT-O Scattergram. LS-MS BMP | ED | 13160 | PLT-O Scattergram. LS-MS BMP | 99MRC | 13160^PLT-O Scattergram. LS-MS BMP^99MRC |
| PLT-O Scattergram. LS-HS BMP | ED | 13161 | PLT-O Scattergram. LS-HS BMP | 99MRC | 13161^PLT-O Scattergram. LS-HS BMP^99MRC |
| PLT-O Scattergram. HS-MS BMP | ED | 13162 | PLT-O Scattergram. HS-MS BMP | 99MRC | 13162^PLT-O Scattergram. HS-MS BMP^99MRC |
| RET-EXT Scattergram. LS-MS BMP | ED | 13163 | RET-EXT Scattergram . LS-MS BMP | 99MRC | 13163^RET-EXT Scattergram. LS-MS BMP^99MRC |
| RET-EXT Scattergram. LS-HS BMP | ED | 13164 | RET-EXT Scattergra m. LS-HS BMP | 99MRC | 13164^RET-EXT Scattergram. LS-HS BMP^99MRC |
| Data | HL7 Type (OBX-2) | Code (ID) | Name | EncodeSys | OBX-3 Segment example |
| RET-EXT Scattergram. HS-MS BMP | ED | 13165 | RET-EXT Scattergram . HS-MS BMP | 99MRC | 13165^RET-EXT Scattergram. HS-MS BMP^99MRC |
| NRBC Scattergram. LS-MS BMP | ED | 13166 | NRBC Scattergram. LS-MS BMP | 99MRC | 13166^NRBC Scattergram. LS-MS BMP^99MRC |
| NRBC Scattergram. LS-HS BMP | ED | 13167 | NRBC Scattergram. LS-HS BMP | 99MRC | 13167^NRBC Scattergram. LS-HS BMP^99MRC |
| NRBC Scattergram. HS-MS BMP | ED | 13168 | NRBC Scattergram. HS-MS BMP | 99MRC | 13168^NRBC Scattergram. HS-MS BMP^99MRC |
| | | | | | |
| Abnormal alarm information | | | | | |

| | | | | | |
|---------------------|-----------------|-----------|---------------------|-----------|---------------------------------|
| Leucocytosis | IS | 14101 | Leucocytosis | 99MRC | 14101^Leucocytosis^99MRC |
| leukopenia | IS | 14102 | Leucopenia | 99MRC | 14102^Leucopenia^99MRC |
| Neutrophilia | IS | 14103 | Neutrophilia | 99MRC | 14103^Neutrophilia^99MRC |
| Neutropenia | IS | 14104 | Neutropenia | 99MRC | 14104^Neutropenia^99MRC |
| Lymphocytosis | IS | 14105 | Lymphocytosis | 99MRC | 14105^Lymphocytosis^99MRC |
| Lymphopenia | IS | 14106 | Lymphopenia | 99MRC | 14106^Lymphopenia^99MRC |
| Monocytosis | IS | 14107 | Monocytosis | 99MRC | 14107^Monocytosis^99MRC |
| Eosinophilia | IS | 14108 | Eosinophilia | 99MRC | 14108^Eosinophilia^99MRC |
| Basophilia | IS | 14109 | Basophilia | 99MRC | 14109^Basophilia^99MRC |
| Neutrophilia | IS | 14110 | Neutrophilia | 99MRC | 14110^Neutrophilia^99MRC |
| Neutropenia | IS | 14111 | Neutropenia | 99MRC | 14111^Neutropenia^99MRC |
| Data item | HL7 Type(OBX-2) | Code (ID) | Name | EncodeSys | OBX-3 Segment example |
| Decreased Mid Cells | IS | 14112 | Decreased Mid Cells | 99MRC | 14112^Decreased Mid Cells^99MRC |
| Increased Mid Cells | IS | 14113 | Increased Mid Cells | 99MRC | 14113^Increased Mid Cells^99MRC |
| rstRBC? | IS | 34525-6 | rstRBC? | LN | 34525-6^rstRBC^LN |
| WBC Left Shift? | IS | 17790-7 | WBC Left Shift? | LN | 17790-7^WBC Left Shift?^LN |
| ImmGranulocyt | | | ImmGranulocyte | | 34165-1^ImmGranulocytes?^LN |

| | | | | | |
|----------------------------|------------------|-----------|----------------------------|-----------|--|
| es? | IS | 34165-1 | s? | LN | |
| Atypical Lymphs? | IS | 15192-8 | Atypical Lymphs? | LN | 15192-8^Atypical Lymphs?^LN |
| Background/Aspiration Abn. | IS | 14001 | Background/Aspiration Abn. | 99MRC | 14001^Background/Aspiration Abn.^99MRC |
| WBC Abnormal | IS | 14002 | WBC Abnormal | 99MRC | 14002^WBC Abnormal^99MRC |
| Abn. WBC scattergram | IS | 14003 | Abn. WBC scattergram | 99MRC | 14003^Abn. WBC scattergram ^99MRC |
| Abn. WBC histogram | IS | 14004 | Abn. WBC histogram | 99MRC | 14004^Abn. WBC histogram ^99MRC |
| Abnormal WBC Channel | IS | 14005 | Abnormal WBC Channel | 99MRC | 14005^Abnormal WBC Channel^99MRC |
| Abnormal DIFF Channel | IS | 14006 | Abnormal DIFF Channel | 99MRC | 14006^Abnormal DIFF Channel^99MRC |
| Anisocytosis | IS | 15150-6 | Anisocytosis | LN | 15150-6^Anisocytosis^LN |
| Macrocytes | IS | 15198-5 | Macrocytes | LN | 15198-5^Macrocytes^LN |
| Microcytes | IS | 15199-3 | Microcytes | LN | 15199-3^Microcytes^LN |
| Hypochromia | IS | 15180-3 | Hypochromia | LN | 15180-3^Hypochromia^LN |
| Erythrocytosis | IS | 14301 | Erythrocytosis | 99MRC | 14301^Erythrocytosis^99MRC |
| Anemia | IS | 14302 | Anemia | 99MRC | 14302^Anemia^99MRC |
| RBC Dual Pop | IS | 10379-6 | RBC Dual Pop | LN | 10379-6^RBC Dual Pop^LN |
| Data | HL7 Type (OBX-2) | Code (ID) | Name | EncodeSys | OBX-3 Segment Example |
| RBC Abnormal distribution | IS | 14201 | RBC Abnormal distribution | 99MRC | 14201^RBC Abnormal distribution^99MRC |
| RBC Clump? | | | | | 14202^RBC Clump?^99MRC |

| | | | | | |
|---------------------------|----|--------|---------------------------|-------|--|
| | IS | 14202 | RBC Clump? | 99MRC | |
| Iron Deficiency? | IS | 14203 | Iron Deficiency? | 99MRC | 14203^Iron Deficiency?^99MRC |
| HGB Interfere | IS | 14204 | HGB Interfere | 99MRC | 14204^HGB Interfere^99MRC |
| Abnormal RBC Channel | IS | 14205 | Abnormal RBC Channel | 99MRC | 14205^Abnormal RBC Channel^99MRC |
| Abnormal HGB Channel | IS | 14206 | Abnormal HGB Channel | 99MRC | 14206^Abnormal HGB Channel^99MRC |
| Thrombocytosis | IS | 14501 | Thrombocytosis | 99MRC | 14501^Thrombocytosis^99MRC |
| Thrombopenia | IS | 14502 | Thrombopenia | 99MRC | 14502^Thrombopenia^99MRC |
| PLT Abnormal Distribution | IS | 14401 | PLT Abnormal Distribution | 99MRC | 14401^PLT Abnormal Distribution^99 MRC |
| Platelet Clump? | IS | 7796-6 | Platelet Clump? | LN | 7796-6^Platelet Clump?^LN |
| CRP Increased | IS | 14701 | CRP Increased | 99MRC | 14701^CRP Increased^99MRC |
| HS-CRP Increased | IS | 14702 | HS-CRP Increased | 99MRC | 14702^HS-CRP Increased^99MRC |
| CRP Abnormal CRP Channel | IS | 14601 | Abnormal CRP Channel | 99MRC | 14601^Abnormal CRP Channel^99MRC |

Communication parameter unit table:

| Parameter unit on software interface | Communication parameter unit (OBX-6) |
|--------------------------------------|--------------------------------------|
| 10^12/L | 10*12/L |
| 10^9/L | 10*9/L |
| 10^6/uL | 10*6/uL |
| 10^4/uL | 10*4/uL |

| | |
|---------------------|---------|
| 10 ³ /uL | 10*3/uL |
| 10 ² /uL | 10*2/uL |
| mL/L | mL/L |
| /nL | /nL |
| /pL | /pL |
| g/L | g/L |
| g/dL | g/dL |
| L/L | L/L |
| mmol/L | mmol/L |
| % | % |
| fL | fL |
| um ³ | um3 |
| pg | pg |
| fmol | fmol |
| amol | amol |
| Age (age unit) | yr |
| Month (age unit) | mo |
| Week (age unit) | w |
| Day (age unit) | d |
| Hour (age unit) | hr |

OBX message data adopts custom enumeration values. The value significance of some key data is shown in the following table:

| Data item | Enumeration values |
|-----------|---|
| Take Mode | <p>"O":Open</p> <p>"A": Automatic</p> <p>"C": Close</p> |

| | |
|---|--|
| Blood Mode | <p>"W": whole blood</p> <p>"P": prediluted</p> |
| Test Mode | <p>CBC; CBC+DIFF ; CRP ; CBC+CRP</p> <p>CBC+DIFF+CRP;</p> |
| Blood Type | <p>AB blood type: "A" , "B" , "AB" and "O"</p> <p>RH blood type: "RH+" , "RH-"</p> |
| Qc Level | <p>"L": Low</p> <p>"M": middle</p> <p>"H": high</p> |
| Histogram classification line adjustment sign and each alarm sign | <p>OBX-2 datatype is "IS", like follows:</p> <p>"T": true</p> <p>"F": false</p> |

4.3 Histogram scatter diagram transmission

There are 3 options:

- 1) Histogram/scatterplot data is not transmitted. No image data transmission when sending data to LIS.
- 2) Bitmap transmission (Include Print Bitmap and Raw Bitmap): The data type field takes the value "ED" in the transmission bitmap data OBX message segment, and the data field takes the form like "^ Image ^ BMP ^ Base64 ^Scatter / Histogram Bitmap Data.....". The "Image ^ BMP ^ Base64" means transmit message via BMP-type bitmap data encoded of Base64. Bitmap formats such as "Print Bitmap (gray scale, white base)" and "Raw Bitmap (color, black base)" are all standard bitmap formats, difference is the color information. For

the Bitmap format, after the LIS receives the bitmap data, do the BASE64 decoding, save without parsing. It is recommended to receive that by bitmap mode.

- 3) Raw Data transmission: Transmit scatter gram or histogram data in binary. The data type field takes the value "ED" in the transmitted binary data OBX message segment, "^Application ^ Octet-stream ^ Base64 ^.....scatter / histogram bitmap data.....", the "^Application ^ Octet-stream ^ Base64 ^" represents a binary data type which has been encoded via Base64 ("Application ^ Octet-stream" represents an application-defined binary data type). Raw data transmission requires a dedicated parsing module, data parsing is quite complicated, only use for internal database management software, unavailable for LIS currently.