P0180 SeraQ LIAISON

REF P0180

The kit insert contains a detailed protocol and should be read carefully before testing the run control to ensure optimal performance

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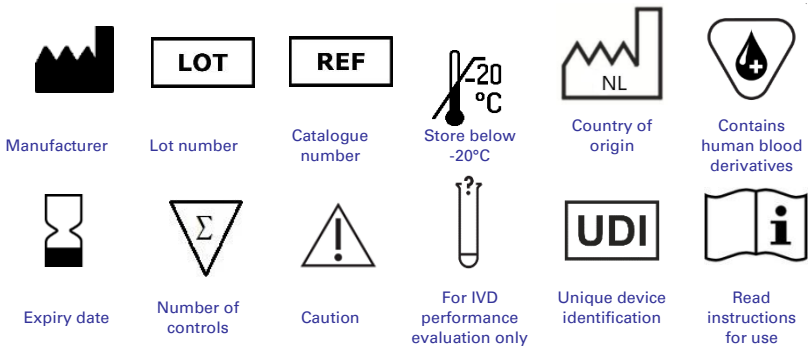
Intended Use

P0180 SeraQ LIAISON is intended to be used on the DiaSorin LIAISON® platform in diagnostic and blood screening laboratories as an external run control in combination with the assays for the detection of hepatitis B surface antigen (HBsAg), antibodies to hepatitis C virus (anti-HCV) and antibodies to human immunodeficiency virus (anti-HIV) (Table 1). P0180 SeraQ LIAISON is a multi-marker mixture of inactivated HBsAg, anti-HCV and anti-HIV-1 standards in defibrinated plasma giving a low reactive result in the DiaSorin LIAISON® Assays. The run control is intended for testing in consecutive runs of the immunoassays over time by trained laboratory workers. By comparison of the sample to cut off (S/CO) values for the three markers found on P0180 SeraQ LIAISON one can monitor whether the analytical sensitivity of test runs is consistent. The run control should not be used to replace internal controls or calibrators in the test kits. The test result on the run control should not be used to reject the run or delay the release of test results on donor or patient samples. This product is used for performance evaluation only.

Table 1. Test kits covered by this run control

Equipment	Agent	Tests
LIAISON®	Hepatitis B virus	DiaSorin LIAISON® HBsAg QUANT
	Hepatitis C virus	DiaSorin LIAISON® HCV-Ab
	Human immunodeficiency virus	DiaSorin LIAISON® HIV Ab/Ag

Key to Symbols Used



Principle of method

A series of SeraQ run controls has been designed for monitoring HBsAg, anti-HCV and anti-HIV-1 test performance. The run control tubes are barcoded and can be placed at random positions in sample racks of the blood screening device. The tubes are comparable in size to donor blood collection tubes. The run controls are designed to mimic naturally occurring serum specimens with low reactivity for HBsAg, anti-HCV and anti-HIV-1. The analytical sensitivity of test kits from different manufacturers varies and therefore for each combination of test kits a separate multi-marker run control has been designed. This SeraQ run control series includes the product P0180 SeraQ LIAISON for which the composition is optimised for use with the DiaSorin LIAISON® test system. The P0180 SeraQ LIAISON run control is designed to generate assay response values (i.e. S/CO ratios) for anti-HCV and anti-HIV-1 and International Units per mL (IU/mL) for

HBsAg) positioned in the low positive range of the assays. Routine use of external run controls enables laboratories to monitor day-to-day test performance and *in-vitro* medical device (IVD) reagent lot variation. A summary of the safety and performance of the P0180 SeraQ LIAISON run control will be published at the EUDAMED website of the European Union[1].

Traceability of antigen and antibody concentrations

For each HBsAg, anti-HIV-1 and anti-HCV, an internal serum standard has been established[2] from which reference panels and run controls are prepared by gravimetrically recorded dilution steps. The undiluted S0001 standard for HBsAg is derived from the same purified heat-inactivated source material as is used for preparation of the 2nd WHO HBsAg adw2 (00/588) International Standard (IS)[3,4]. Studies with the later established WHO international hepatitis B virus genotype reference panel showed that the heat-inactivation of HBsAg in the International Standard had little impact on the detectability in immuno-assays[4]. The HBsAg concentration in the run control has been set at 0.11 IU/mL based on the dilution factor of the HBsAg standard[2,3]. During manufacturing of SeraQ run controls the measurable HBsAg concentration reduces to a certain extent depending on the test method. One IU of heat-inactivated HBsAg was found to be equivalent to 0.67 nanogram ng HBsAg when historically calibrated against the first HBsAg standard established by the Paul Ehrlich Institute (1st PEI HBsAg standard), comparable to conversion factors of 0.58 and 0.71 reported in WHO collaborative studies[3,4,6]. The S0001 HBsAg standard used for preparation of the SeraQ run controls has been instrumental in studies to establish the length of pre-HBsAg infectious window period and infectivity of HBsAg positive blood without detectable hepatitis B virus (HBV)-DNA[7,8]. No unitage could be assigned to the internal standards for anti-HIV-1 and anti-HCV since international reference preparations are not available. The consistent concentration of the analytes in consecutive SeraQ control batches is guaranteed by release testing against a reference batch of the run control kept frozen at -30°C. These reference batches are derived from the same undiluted internal standards that are used for manufacturing of the SeraQ run controls.

Kit contents (materials provided)

The run control contains human serum with 0.01% (w/v) Thimerosal as preservative and is provided in two formats as detailed in Table 2.

Table 2. Description of kit formats and contents

Cat. Code	GTIN/UDI-DI code^	Quantity run control	Tube size	Claimed sample volume	Secondary packaging
P0180/01	8718719833681	60 x 2.0 mL	10 mL	1.9 mL (+overfill)	60 tube rack in box
P0180/02	8718719831816	10 x 2.0 mL	10 mL	1.9 mL (+overfill)	10 tubes in bag

^Global Trade Item Number = Unique Device Identification – Device Identifier (UDI-DI) code

The basic UDI code (or Global Model Number (GMN)) of the P0180 SeraQ LIAISON run control is 871871983P0180EQ.

To facilitate automation the run control is presented in a polypropylene tube with screw cap comparable in size to vacutainer tubes used for donor sample collection. In addition,

the label includes a barcode identifying the product, sequential batch number and multi-marker: MM. The barcode of each run control tube can be read by the DiaSorin LIAISON instruments.

Materials not provided

Pipetting devices in IVD test systems, a vortex instrument for thorough mixing of samples prior to use and a water bath of 37°C for quickly thawing of run control are not provided.

Storage Instructions

Store unopened tubes at or below -20°C. For each LIAISON instrument thaw one run control tube in a water bath of 37°C until ice clot has disappeared. After thawing, the run control tubes should be stored at 2°C to 8°C for no longer than one week.

Warning and precautions

P0180 SeraQ LIAISON run controls are prepared from serum standards, in which virus has been inactivated by *in vivo* validated methods applied in the plasma industry[2]. Infectivity and inactivation data have been analysed to demonstrate absence of residual infectivity of HBV, HCV and HIV-1 in the run controls[2]. The serum matrix in the run controls has been tested for infectious disease markers by serologic and molecular screening methods. However, no screening procedure can offer complete assurance that products derived from human blood cannot transmit undetected infectious agents. The run control should only be used by trained laboratory workers who are aware of the potential risk of infectious agents in human serum samples and take the necessary precautions.

- SeraQ run controls should be handled with the normal preventive measures in a serology laboratory[9,10].
- This product contains human plasma and traces of biological source material of non-human origin (bovine thrombin).
- The use of the run control in other assay configurations should be avoided and is not supported by the manufacturer.
- Wear disposable gloves when handling samples.
- Do not eat drink, smoke or apply cosmetics in areas where specimens are handled.
- Do not pipette by mouth.
- If skin or mucous membrane exposure occurs, immediately wash the area with copious amounts of water.
- Disinfect spills using a 0.5% hypochlorite solution (1:10 v/v household bleach) or equivalent disinfectant.
- Dispose unused or spilled materials according to the normal practices for biological waste disposal in your institution.
- If precipitates are visible, mix the run controls for 2 minutes thoroughly using a vortex instrument.
- Do not use run controls beyond one week storage at 2-8°C.
- Store run controls in an upright position.
- Validation of the diagnostic test results must be based on the specifications set by the manufacturer of the IVD test kit and not be influenced by the test result on the run control.

Reagent preparation

- For first use of the run control thaw the tube quickly in a water bath at 37°C.
- Mix gently during thawing until contents are just thawed.
- Immediately after ice clot has disappeared remove the run control tube from the water bath.
- Before testing allow the run control tube to adapt to room temperature.
- Mix the run control tube thoroughly prior to use using a vortex instrument.
- Place the run control tube at the specified positions in the sample rack of the LIAISON system for regular or patient samples.
- Test on the DiaSorin LIAISON platform with the assays mentioned in Table 1 according to the manufacturer's instructions
- Store the opened tube immediately after use at 2-8 °C (see storage instructions).

Analytical Performance Characteristics

SeraQ run controls have been designed by examination of the response curves on dilutions of the internal standards and as such relate to the analytical sensitivity of immunoassays. In the following paragraphs the essential analytical performance characteristics of SeraQ run controls are presented.

Dose response and analytical sensitivity

By analysing standard dilution series the relationship between S/CO values and concentration of the analyte can be established[11,12]. Plotting log transformed S/CO values against log concentration analyte using linear regression analysis enables calculation of correlation coefficients. Figure 1a shows a linear dose response relation between the input HBsAg concentration and the reported IU/mL values by the DiaSorin HBsAg QUANT assay for which no transformation is required. The arrow indicates the expected response at the run control concentration set at 0.11 IU/mL. Figures 1b and 1c show linear dose response relations in the DiaSorin LIAISON® anti-HCV and HIVAb/Ag assays obtained after log transformation of dilution and S/CO values.

Figure 1a. Dose response in HBsAg QUANT assay. IU/mL input plotted against IU/mL measured (r^2=0.99).

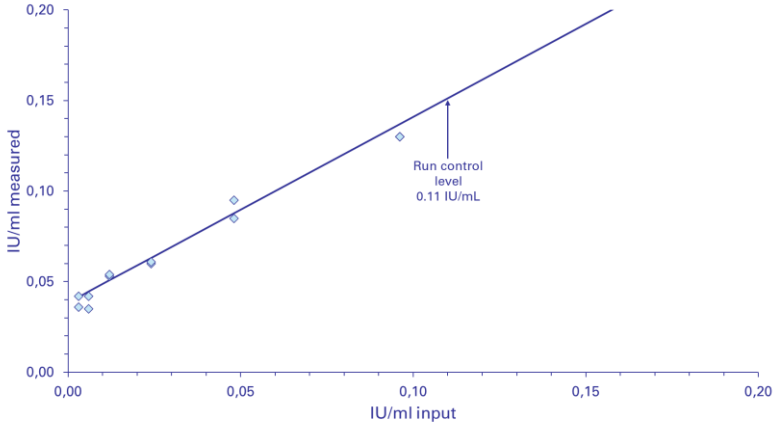


Figure 1b. Dose response in anti-HCV assay. Log anti-HCV S/CO values are plotted against log dilution (r^2 = 0.99).

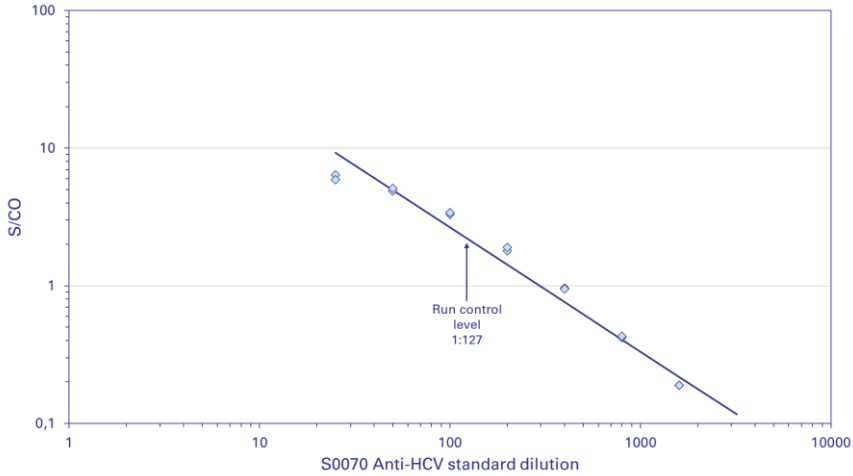
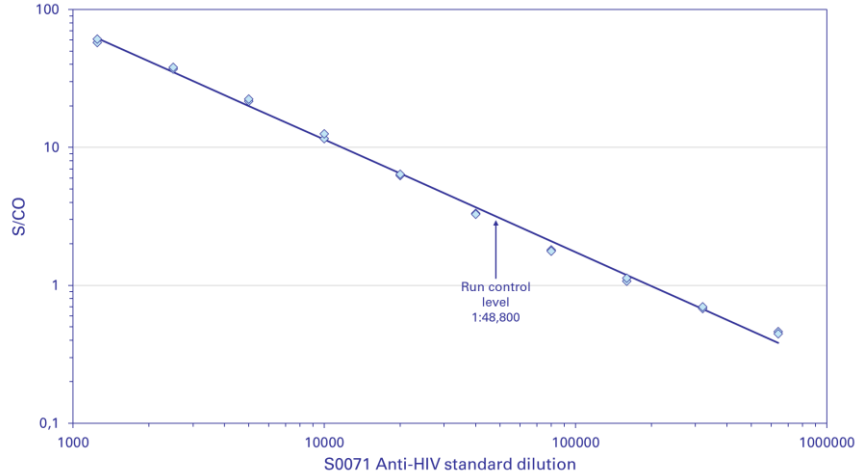


Figure 1c. Dose response in HIV Ag/Ab assay. Log HIVAb/Ag S/CO values are plotted against log dilution ($r^2 = 0.998$).



Expected assay response values

The expected results for the P0180 SeraQ LIASON run control are follows:

1. HBsAg range: 0.06 – 0.18 IU/mL
2. anti-HIV range S/CO ratio: 1.8 – 3.3
3. anti-HCV range S/CO ratio: 2.3 – 3.7

Each LIAISON reagent lot appears to have its own dose response curve and distribution of S/CO values on SeraQ run controls. This depends on the analytical sensitivity of the DiaSorin LIAISON reagent batches that are in use. Thus, it cannot be guaranteed that the assay response values will always fall within these ranges. P0180 SeraQ LIAISON run control serves as an independent standard for monitoring consistent analytical sensitivity of LIAISON reagent lots over time.

Interpretation of Results

Calculations

Subsequent test runs can be analysed by appropriate statistical approaches on the S/CO ratios and HBsAg concentrations obtained on the external control samples. A software system (DataQ Analytics) is available via the website www.bioqcontrol.com for entering S/CO values and generating a statistical report with the following calculations for preparing a Levey-Jennings chart:

Transforming Assay response values

To obtain the test kit batch specific reference values for each marker, an initial collection of at least 30 consecutive test results is required. Upon collecting additional data the chart characteristics may be updated.

- HBsAg concentrations are 'normally' distributed. For the HBsAg assay the LIAISON software calculates a quantitative HBsAg value in IU/mL. This value can be directly used for calculation of the average and confidence intervals:
  - Calculate average expressed in IU/mL and its standard deviation.
  - Use Table 3 to obtain Student-t-values belonging to the 95% and 99% confidence interval (CI) for different number of observations (n)
  - Calculate the 95% and 99% CI as follows:
    99% Lower limit: Average – (99%) Student-t-Value x Standard Deviation
    95% Lower limit: Average – (95%) Student-t-Value x Standard Deviation
    95% Upper limit: Average + (95%) Student-t-Value x Standard Deviation
    99% Upper limit: Average + (99%) Student-t-Value x Standard Deviation
  - To visualize the individual IU/mL values make a Levey-Jennings plot on a linear scale (see Figure 2a).
- The S/CO values for anti-HIV and anti-HCV are 'log normally' distributed. For the LIAISON anti-HCV and HIV-combo assays one should use the logarithm of S/CO ratios for calculation of the geometric mean and confidence interval.
  - Calculate from each measurement the log S/CO value.
  - Calculate average and standard deviation on these log transformed values; log (Average) and log (Standard Deviation).
  - Calculate the (geometric) mean in S/CO ratio by taking the anti-log value of the log (Average)
  - Use Table 3 to obtain Student-t-values belonging to the 95% and 99% CI for different number of observations (n)
  - Calculate the log(95% and 99% CI) as follows:
    Log (99% Lower limit): log (Average) – (99%) Student-t-Value x log (Standard Deviation)
    Log (95% Lower limit): log (Average) – (95%) Student-t-Value x log (Standard Deviation)
    Log (95% Upper limit): log (Average) + (95%) Student-t-Value x log (Standard Deviation)
    Log (99% Upper limit): log (Average) + (99%) Student-t-Value x log (Standard Deviation)
  - Take the anti-log values for calculating the confidence limits in S/CO ratio. To visualize the individual S/CO values make a Levey-Jennings control chart on a linear scale. S/CO ratios plotted on a linear scale depict the upper 95% and 99% confidence limits at greater distance from the geometric mean S/CO value than the lower confidence limits (see examples in Figure 2b and 2c).

Levey-Jennings chart

The Levey-Jennings chart is a graph in which quality control results are plotted over subsequent test runs in time to give a visual indication when a laboratory test is (not) working well. The data points for each test run in the scatter plots below (Figure 2a,b and c) show the distance from the geometric mean S/CO ratio (green line in graph)

which is the expected response level for the run control. The orange and red lines represent the 95% and 99% CI, respectively. The data represents individual measurements of three instruments.

Table 3. Relation of Student t value and numbers of runs (n) to calculate confidence intervals.

Runs (n)	t-value at 95% CI	t-value at 99% CI
10	2.306	3.355
20	2.101	2.878
30	2.048	2.763
Infinite	1.960	2.576

Infinite equals the normal distribution

Figure 2. Levey-Jennings charts of P0180 SeraQ LIAISON run control results in DiaSorin LIAISON assays. The green line represents the average and the orange and red lines the 95% and 99% confidence intervals (CI) respectively. For anti-HCV and anti-HIV-1 the average (green line) and 95% and 99% CI (orange and red lines) are log transformed as explained in the text.

Figure 2a. LIAISON HBsAg QUANT assay

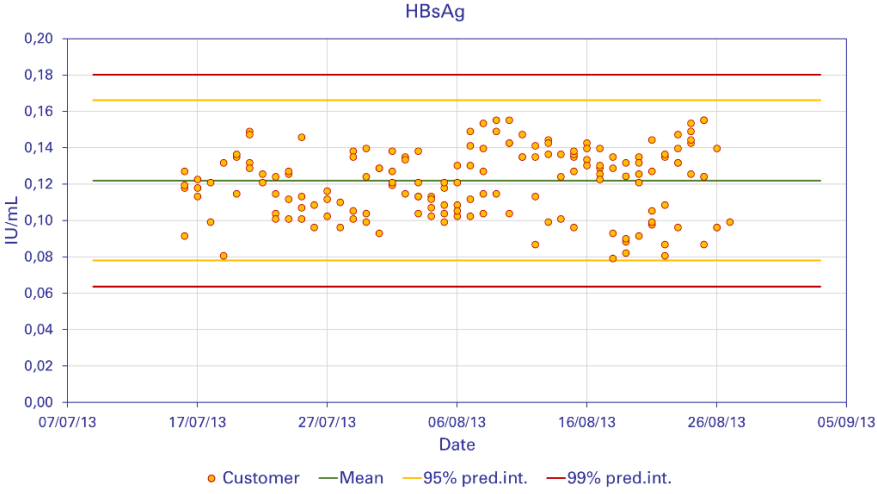


Figure 2b. LIAISON anti-HCV assay.

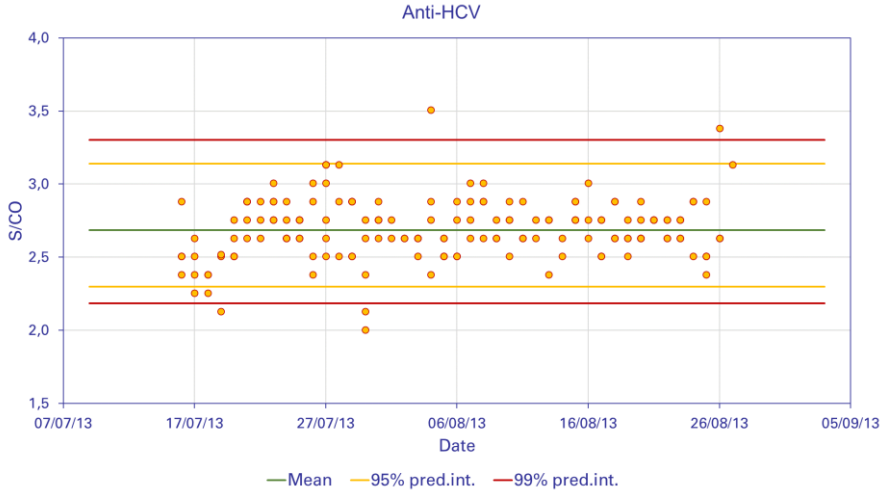
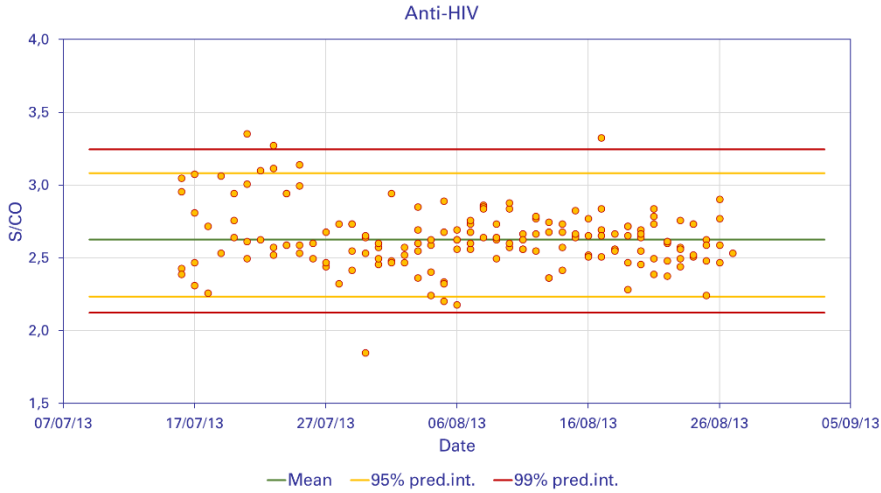


Figure 2c. LIAISON HIV Ag/Ab assay



Interpretation

Knowing the 95% and 99% CI for generating a Levey-Jennings chart one can use Nelson rules[13] to interpret values outside the confidence limits for identifying trends and aberrant results. The statistical report generated by the DataQ Analytics (on the website www.bioqcontrol.com) identifies these trends and outliers for the laboratory requesting the report.

- Negative or positive trends resulting from gradual changes in test performance and not reported by the internal kit controls and/or alert systems in the test robot, are

indicative for a lack of maintenance, the need for recalibration of equipment, or degradation of reagents. These are systematic errors. In case a trend is recognised, the laboratory is encouraged to identify the root cause of the deviation.
- Aberrant results like a negative response on the run control or a result outside the range of 99% CI are indicative for (incidental) random errors that need further investigation to identify the root cause. The identification of the root cause of aberrant results is beyond the scope of the intended use of the run controls.
- Differences between S/CO values of laboratories could be attributed to different reagent lots or run control batches that are in use. The statistical report that can be obtained from the DataQ Analytics system (available on www.bioqcontrol.com) compares the assay response values on different lab instruments, test reagent lots and run control batches

DiaSorin assay response values on P0180 SeraQ LIASON run control

Table 4 gives an example of results obtained within the same LIAISON reagent lots. When a new reagent lot is introduced the values in Table 4 need to be reassessed (see Interpretation of Results).

Table 4. DiaSorin Assay response values on P0180 SeraQ LIAISON run control

DiaSorin Assay	n	average IU/mL	95% CI IU/mL	99% CI IU/mL
HBsAg QUANT	165	0.12	0.08 - 0.17	0.06 - 0.18
		geomean S/CO	95% CI S/CO	99% CI S/CO
HCV-Ab	160	2.69	2.30 - 3.14	2.19 - 3.30
HIV Ab/Ag	166	2.62	2.23 - 3.08	2.12 – 3.24

Variation in immunoassay reagent lots

Variation in S/CO ratio on run controls reflects the difference in analytical sensitivity of assay runs and reagent lots. Different batches of SeraQ run controls are prepared from the same serum standards. As a consequence, the composition of the multi-marker run controls is consistent from batch to batch. This is confirmed by multi-variance analysis on large data sets showing that immunoassay reagent batches are the major source of variation in analytical sensitivity.

Limitations

- SeraQ run controls were designed for monitoring the analytical performance of serologic test systems. They cannot be used to evaluate the diagnostic sensitivity of the assays.
- The run control must not be substituted for the mandatory controls or calibrators provided with IVD test kits for calculating the cut off and/or criteria for releasing test results.
- The response values on the run controls should not be used to release or reject the test run but can be used as an aid in the assessment of analytical performance.
- The expected S/CO values and 99% predictive intervals have been established with a limited number of LIAISON reagent lots. It cannot be guaranteed that S/CO values obtained with new reagent lots will always fall within these limits.
- Although the batch-to batch composition of SeraQ run controls is consistent some variation in the measurable potency of the serum standards in the run control batches cannot be avoided due to matrix effects and other manufacturing variables.

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