

For In Vitro Diagnostic Use

ANNUAL REVIEW

Reviewed by:		Reviewed by:	Date
Refer to coversheet in front of method			

PRINCIPLE

INTENDED USE

GLUCm reagent, when used in conjunction with SYNCHRON LX[®] System(s), UniCel[®] DxH 600/800 System(s) and SYNCHRON[®] Systems AQUA CAL 1 and 2, is intended for the quantitative determination of glucose concentration in human serum, plasma, urine or cerebrospinal fluid (CSF).

CLINICAL SIGNIFICANCE

Glucose measurements are used in the diagnosis and treatment of carbohydrate metabolism disorders including diabetes mellitus, neonatal hypoglycemia, idiopathic hypoglycemia, and pancreatic islet cell carcinoma.

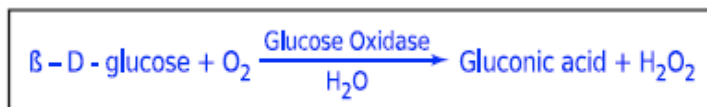
METHODOLOGY

The SYNCHRON[®] System(s) determines GLUCm concentration by an oxygen rate method employing a Beckman Coulter Oxygen electrode.^{1,2}

A precise volume of sample (10 microliters) is injected in a reaction cup containing a glucose oxidase solution. The ratio used is one part sample to 76 parts reagent. The peak rate of oxygen consumption is directly proportional to the concentration of GLUCm in the sample.³

CHEMICAL REACTION SCHEME

Oxygen is consumed at the same rate as glucose reacts to form gluconic acid.



E015161L.EPS

Because oxygen consumption rather than peroxide formation is measured, the only requirement for peroxide is that it must be destroyed by a path not leading back to oxygen. The addition of ethanol to the reagent causes peroxide to be destroyed in the presence of catalase without yielding oxygen, according to the following reaction:



E015162L.EPS

To ensure complete destruction of the peroxide, iodide and molybdate are added to the enzyme reagent, causing the following reaction:



E015163L.EPS

The reaction is effective even after the catalase activity has diminished with length of storage.

SPECIMEN

TYPE OF SPECIMEN

Biological fluid samples should be collected in the same manner routinely used for any laboratory test.⁴ Freshly drawn serum, plasma, CSF or properly collected urine (random/timed) are the preferred specimens. Acceptable anticoagulants are listed in the PROCEDURAL NOTES section of this chemistry information sheet. Whole blood is not recommended for use as a sample. The use of fluoride as a glycolysis inhibitor is recommended.

SPECIMEN STORAGE AND STABILITY

1. Tubes of blood are to be kept closed at all times and in a vertical position. It is recommended that the serum or plasma be physically separated from contact with cells within two hours from the time of collection.⁵
2. Separated serum or plasma should not remain at room temperature longer than 8 hours. If assays are not completed within 8 hours, serum or plasma should be stored at +2°C to +8°C. If assays are not completed within 48 hours, or the separated sample is to be stored beyond 48 hours, samples should be frozen at -15°C to -20°C. Frozen samples should be thawed only once. Analyte deterioration may occur in samples that are repeatedly frozen and thawed.⁵
3. It is recommended that urine assays be performed within 2 hours of collection. For timed specimens, the collection container should be kept in the refrigerator or on ice during the timed period. No preservative is required.⁶
4. CSF specimens should be centrifuged and analyzed without delay.

Additional specimen storage and stability conditions as designated by this laboratory:

Refer to "Sample Integrity in Chemistry" write up in "Policies and Procedures" manual

SAMPLE VOLUME

A filled 0.5 mL sample cup is the optimum volume. For optimum primary sample tube volumes in primary tube samples and minimum volumes, refer to the Primary Tube Sample Template for your system.

CRITERIA FOR UNACCEPTABLE SPECIMENS

Refer to the PROCEDURAL NOTES section of this chemistry information sheet for information on unacceptable specimens.

Criteria for sample rejection as designated by this laboratory:

Refer to "Sample Integrity in Chemistry" write up in "Policies and Procedures" manual

PATIENT PREPARATION

Special instructions for patient preparation as designated by this laboratory:

Refer to "Sample Integrity in Chemistry" write up in "Policies and Procedures" manual

SPECIMEN HANDLING

Special instructions for specimen handling as designated by this laboratory:

Refer to "Sample Integrity in Chemistry" write up in "Policies and Procedures" manual

REAGENTS

CONTENTS

Each kit contains the following items:

Two Glucose Reagent Bottles (2 x 2 L)

VOLUMES PER TEST

Sample Volume	10 µL
ORDAC Sample Volume	5 µL
Total Reagent Volume	765 µL

REACTIVE INGREDIENTS

REAGENT CONSTITUENTS

Glucose Oxidase	150 U/mL
Denatured Ethanol	5%
Potassium Iodide	0.04 mol/L
Ammonium Molybdate	0.03 mol/L

Also non-reactive chemicals necessary for optimal system performance.

EUROPEAN HAZARD CLASSIFICATION

Glucose Reagent (Glucose Oxidase)	Xn;R10-42	Flammable. May cause sensitization by inhalation.
	S16	Keep away from sources of ignition - No smoking.
	S36	Wear suitable protective clothing.
	S7	Keep container tightly closed.

MATERIALS NEEDED BUT NOT SUPPLIED WITH REAGENT KIT

SYNCHRON[®] Systems AQUA CAL 1 and 2
At least two levels of control material
Saline

REAGENT PREPARATION

Prior to use, allow the glucose reagent to equilibrate to room temperature for at least 8 hours. A +25°C water bath may be used to warm reagent. Invert reagent 5 times to mix.

Inspect for crystals and if present, see instructions for frozen reagent in Reagent Storage and Stability.

ACCEPTABLE REAGENT PERFORMANCE

The acceptability of a reagent is determined by successful calibration and by ensuring that quality control results are within your facility's acceptance criteria.

REAGENT STORAGE AND STABILITY

GLUCm reagent stored unopened at +2°C to +8°C is stable until the expiration date indicated on each bottle. The reagent is stable on instrument for 30 days or until the expiration date, if sooner.

If reagent is frozen in transit, thaw completely, warm to room temperature and mix thoroughly by gently inverting bottle a least 10 times.

Reagent storage location:

[Chemistry section, room L568. Refer to reagent "map" on Chemistry refrigerator #6.](#)

CALIBRATION

CALIBRATOR REQUIRED

SYNCHRON[®] Systems AQUA CAL 1 and 2

CALIBRATOR PREPARATION No

preparation is required.

CALIBRATOR STORAGE AND STABILITY

1. If unopened, the calibrators should be stored at +2°C to +8°C until the expiration date printed on the calibrator bottle. Once opened, the calibrators are stable at room temperature for 30 days.
2. Repetitive refrigeration of the aqueous calibrators may facilitate crystal formation. Once removed from refrigerated storage, these calibrators should remain at room temperature.

Calibrator storage location:

Opened Aqua Cal bottles kept at room temperature (monitored daily) in Chemistry department room L568. Unopened Aqua Cal bottles kept in Chemistry refrigerator #6 in Chemistry department room L568.

CALIBRATION INFORMATION

1. The system must have a valid calibration in memory before controls or patient samples can be run.
2. Under typical operating conditions the GLUCm assay must be calibrated every 48 hours or with each new bottle of reagent and also with certain parts replacements or maintenance procedures, as defined in the SYNCHRON LX Maintenance Manual and Instrument Log, or the UniCel DxC 600/800 Systems Instructions for Use (IFU) manual. Calibration may be required if the system is powered down for more than five minutes.
3. For detailed calibration instructions, refer to the SYNCHRON LX Operations Manual, or the UniCel DxC 600/800 System Instructions For Use (IFU) manual.
4. The system will automatically perform checks on the calibration and produce data at the end of calibration. In the event of a failed calibration, the data will be printed with error codes and the system will alert the operator of the failure. For information on error codes, refer to the SYNCHRON LX Diagnostics and Troubleshooting Manual, or the UniCel DxC 600/800 System Instructions For Use (IFU) manual.

TRACEABILITY

For Traceability information refer to the Calibrator instructions for use.

QUALITY CONTROL

At least two levels of control material should be analyzed daily. In addition, these controls should be run with each new calibration, with each new bottle of reagent, and after specific maintenance or troubleshooting procedures as detailed in the appropriate system manual. More frequent use of controls or the use of additional controls is left to the discretion of the user based on good laboratory practices or laboratory accreditation requirements and applicable laws.

The following controls should be prepared and used in accordance with the package inserts. Discrepant quality control results should be evaluated by your facility.

NOTICE

Do not use controls containing diethylamine HCl.

Table 1.0 Quality Control Material

CONTROL NAME	SAMPLE TYPE	STORAGE
<p>Monitrol levels 1 and 2 vials in use kept refrigerated after thawing. Unopened Monitrol kept frozen until just before use. Refer to "DXC 800 Control Analysis" in DXC 800 procedure manual for other control material used and storage. Control preparations and acceptance of QC results are in "Policies and Procedures" manual</p>		

TESTING PROCEDURE(S)

1. If necessary prepare reagent as defined in the Reagent Preparation section of this chemistry information sheet and load the reagent onto the system.
2. After reagent load is completed, calibration is required.
3. Program samples and controls for analysis.
4. After loading samples and controls onto the system, follow the protocols for system operations.

CALCULATIONS

The SYNCHRON[®] System(s) performs all calculations internally to produce the final reported result. The system will calculate the final result for sample dilutions made by the operator when the dilution factor is entered into the system during sample programming.

REPORTING RESULTS

Equivalency between the SYNCHRON LX and UniCel DxC 600/800 Systems has been established. Chemistry results between these systems are in agreement and data from representative systems may be shown.

REFERENCE INTERVALS

Each laboratory should establish its own reference intervals based upon its patient population. The reference intervals listed below were taken from literature and a study performed on SYNCHRON Systems.⁷

Table 2.0 Reference intervals

INTERVALS	SAMPLE TYPE	CONVENTIONAL UNITS	S.I. UNITS
Literature	Serum or Plasma	74 – 106 mg/dL	4.1 – 5.9 mmol/L
	Urine ^a	1 – 15 mg/dL	0.06 – 0.83 mmol/L
	Urine (timed) ^a	< 0.5 g/24 hrs	< 2.8 mmol/24 hrs
	CSF	40 – 70 mg/dL	2.2 – 3.9 mmol/L
SYNCHRON	Serum or Plasma	74 – 118 mg/dL	4.1 – 6.6 mmol/L

^a In a healthy patient, the normal urine glucose value is zero.

INTERVALS	SAMPLE TYPE	AGE	CONVENTIONAL UNITS
Laboratory	Serum or Plasma, Non-fasting	<1 month	55 – 115 mg/dL
		1 month - < 1 year	55 – 123 mg/dL
		1 year - < 18 years	56 – 145 mg/dL
		≥ 18 years	70 – 199 mg/dL
	Serum or Plasma, fasting	Normal	70 – 99 mg/dL
		Suggests impaired glucose hemostasis	100 – 125 mg/dL
		Diabetes Mellitus	>125 mg/dL
	Urine		<0.5 g/day
	CSF		40-70 mg/dL

Refer to References (8,9,10) for guidelines on establishing laboratory-specific reference intervals.

1. Normal range for infants 0 to <1 month adapted from Soldin, Steven J., "Pediatric Reference Intervals", 6th edition, AACCPress, 2007, method 1.
2. Normal range for 1 month to <18 years adapted from Beckman Coulter's "Pediatric Reference Range Guidelines for Synchron Systems" Bulletin 9345
3. ADA guidelines used for adults.

Additional reporting information as designated by this laboratory:

Refer to "DXC800 Linearity and Reportable Range" chart in Technical notes section of DXC800 Procedure manual

PROCEDURAL NOTES

ANTICOAGULANT TEST RESULTS

If plasma is the sample of choice, the following anticoagulants were found to be compatible with this method:

Table 3.0 Compatible Anticoagulants

ANTICOAGULANT	LEVEL TESTED FOR IN VITRO INTERFERENCE	AVERAGE PLASMA-SERUM BIAS (mg/dL)
Ammonium Heparin	14 Units/mL	NSI ^a
Lithium Heparin	14 Units/mL	NSI
Sodium Heparin	14 Units/mL	NSI
Potassium Oxalate/Sodium Fluoride	2.0 / 2.5 mg/mL	NSI

a NSI = No significant Interference (within ±4.0 mg/dL or 4%).

LIMITATIONS

1. If sodium fluoride is used as a preservative, a decrease of 9 mg/dL is seen during the first 2 hours.⁷
2. If urine or CSF samples are cloudy or turbid or if CSF samples are visibly contaminated with blood, it is recommended that they be centrifuged before transfer to a sample cup.
3. Freshly prepared D-glucose solutions or commercial controls spiked with D-glucose must be allowed to mutarotate before analysis for accurate results.
4. Oxygenated samples will cause low results. Dilute samples 1:1 with saline or use the hexokinase cartridge method.

INTERFERENCES

1. The following substances were tested for interference with this methodology:

SUBSTANCE	SOURCE	LEVEL TESTED	OBSERVED EFFECT
Bilirubin (unconjugated)	Bovine	30 mg/dL	NSI ^a

Table 4.0 Interferences

Table 4.0 Interferences, Continued

SUBSTANCE	SOURCE	LEVEL TESTED	OBSERVED EFFECT
Hemoglobin	RBC hemolysate	500 mg/dL	NSI
Lipemia	Intralipid ^b	500 mg/dL	NSI

a NSI = No significant Interference (within ± 4.0 mg/dL or 4%).

b Intralipid is a registered trademark of KabiVitrum, Inc., Clayton, NC 27250.

- Lipemic samples with visual turbidity >3+, or with a Lipemia Serum Index >10, should be ultracentrifuged and the analysis performed on the infranate.
- Refer to References (11,12,13) for other interferences caused by drugs, disease and preanalytical variables.

PERFORMANCE CHARACTERISTICS

ANALYTIC RANGE

The SYNCHRON[®] System(s) method for the determination of this analyte provides the following analytical ranges:

Table 5.0 Analytical Range

SAMPLE TYPE	CONVENTIONAL UNITS	S.I. UNITS
Serum/Plasma/Urine/CSF	10 – 600 mg/dL	0.56 – 33.3 mmol/L
Serum/Plasma/Urine/CSF (ORDAC)	300 – 1200 mg/dL	16.7 – 66.7 mmol/L

Samples with concentrations exceeding the high end of the analytical range should be diluted with saline and reanalyzed.

REPORTABLE RANGE (AS DETERMINED ON SITE):

Table 6.0 Reportable Range

SAMPLE TYPE	CONVENTIONAL UNITS	S.I. UNITS
Serum/Plasma/Urine/CSF (ORDAC)	10 – 1200 mg/dL (dilute if >1200 mg/dL)	n/a

SENSITIVITY

Sensitivity is defined as the lowest measurable concentration which can be distinguished from zero with 95% confidence. Sensitivity for GLUCm determination is 10 mg/dL (0.56 mmol/L).

EQUIVALENCY

Equivalency was assessed by Deming regression analysis of patient samples to accepted clinical methods.

Serum or Plasma (in the range of 26.0 to 568.0 mg/dL):

Y (SYNCHRON LX Systems)	= 0.991X - 0.25
N	= 87
MEAN (SYNCHRON LX Systems)	= 193.7
MEAN (SYNCHRON CX7 DELTA)	= 195.8
CORRELATION COEFFICIENT (r)	= 0.9957

Urine (in the range of 11 to 463 mg/dL):

Y (SYNCHRON LX Systems)	= 1.000X - 5.97
N	= 52
MEAN (SYNCHRON LX Systems)	= 2.19.7
MEAN (SYNCHRON CX7 DELTA)	= 225.7
CORRELATION COEFFICIENT (r)	= 0.998

CSF (in the range of 24.0 to 554 mg/dL):

Y (SYNCHRON LX Systems)	= 0.970X + 1.81
N	= 93
MEAN (SYNCHRON LX Systems)	= 182.1
MEAN (SYNCHRON CX7 DELTA)	= 185.8
CORRELATION COEFFICIENT (r)	= 0.9977

Serum or Plasma (in the range of 10 to 571 mg/dL):

Y (UniCel DxC Systems)	= 1.005X - 0.165
N	= 187
MEAN (UniCel DxC Systems)	= 119.3
MEAN (SYNCHRON LX Systems)	= 118.8
Correlation Coefficient (r)	= 1.000

Urine (in the range of 10 to 628 mg/dL):

Y (UniCel DxC Systems)	= 1.014X + 0.385
N	= 96
MEAN (UniCel DxC Systems)	= 211.0
MEAN (SYNCHRON LX Systems)	= 208.5
Correlation Coefficient (r)	= 1.000

CSF (in the range of 22 to 552 mg/dL):

Y (UniCel DxC Systems)	= 0.982X + 0.43
N	= 93
MEAN (UniCel DxC Systems)	= 215
MEAN (SYNCHRON LX Systems)	= 219
Correlation Coefficient (r)	= 1.000

Refer to References (14) for guidelines on performing equivalency testing.

PRECISION

A properly operating SYNCHRON[®] System(s) should exhibit imprecision values less than or equal to the maximum performance limits in the table below. Maximum performance limits were derived by an examination of the imprecision of various methods, proficiency test summaries, and literature sources.

Table 7.0 Maximum Performance Limits

TYPE OF PRECISION	SAMPLE TYPE	1 SD		CHANGEOVER VALUE ^a		% CV
		mg/dL	mmol/L	mg/dL	mmol/L	
Within-run	Serum/Plasma/Urine/CSF	2.0	0.1	100.0	5.6	2.0
Total	Serum/Plasma/Urine/CSF	3.0	0.2	100.0	5.6	3.0
Within-run	Serum/Plasma/Urine/CSF (ORDAC)	NA ^b	NA	NA	NA	5.0
Total	Serum/Plasma/Urine/CSF (ORDAC)	NA	NA	NA	NA	7.5

a When the mean of the test precision data is less than or equal to the changeover value, compare the test SD to the SD guideline given above to determine the acceptability of the precision testing. When the mean of the test precision data is greater than the changeover value, compare the test % CV to the guideline given above to determine acceptability. Changeover value = (SD guideline/CV guideline) x 100.

b NA = Not applicable.

Comparative performance data for a SYNCHRON LX[®] System evaluated using the NCCLS Proposed Guideline EP5-T2 appears in the table below.¹⁵ Each laboratory should characterize their own instrument performance for comparison purposes.

Table 8.0 NCCLS EP5-T2 Precision Estimate Method

TYPE OF IMPRECISION	SAMPLE TYPE		No. Systems	No. Data Points ^a	Test Mean Value (mg/dL)	EP5-T2 Calculated Point Estimates	
						SD	%CV
Within-run	Serum	Control 1	1	80	43.7	1.3	2.9
	Serum	Control 2	1	80	397.1	1.7	0.4
	Urine	Control 1	1	80	37.1	1.0	2.8
	Urine	Control 2	1	80	289.7	1.8	0.6
	CSF	Control 1	1	80	35.6	0.8	2.2
	CSF	Control 2	1	80	111.4	1.1	1.0
Total	Serum	Control 1	1	80	43.7	1.7	3.9
	Serum	Control 2	1	80	397.1	4.7	1.2
	Urine	Control 1	1	80	37.1	1.5	4.0
	Urine	Control 2	1	80	289.7	8.2	2.8
	CSF	Control 1	1	80	35.6	1.3	3.6
	CSF	Control 2	1	80	111.4	1.9	1.7

a The point estimate is based on the pooled data from one system, run for twenty days, two runs per day, two observations per run on an instrument operated and maintained according to the manufacturer's instructions.

NOTICE

These degrees of precision and equivalency were obtained in typical testing procedures on a SYNCHRON LX[®] System and are not intended to represent the performance specifications for this reagent.

ADDITIONAL INFORMATION


For more detailed information on SYNCHRON LX Systems or UniCel DxC Systems, refer to the appropriate system manual.

SHIPPING DAMAGE

If damaged product is received, notify your Beckman Coulter Clinical Support Center.

REFERENCES

1. Kadish, A. H., Hall, D. A., "A New Method for the Continuous Monitoring of Blood Glucose by Measurement of Dissolved Oxygen", Clin. Chem., 11:869 (1965).
2. Kadish, A. H., Little, R. L., Sternberg, J. C., "A New and Rapid Method for the Determination of Glucose by Measurement of Rate Oxygen Consumption", Clin. Chem., 144:116 (1968).
3. Morrison, B., "Use of the Beckman Glucose Analyzer for Low and High Glucose Values", Clin. Chem. Acta, 42:192 (1972).
4. Tietz, N. W., "Specimen Collection and Processing; Sources of Biological Variation", Textbook of Clinical Chemistry, 2nd Edition, W. B. Saunders, Philadelphia, PA (1994).
5. National Committee for Clinical Laboratory Standards, Procedures for the Handling and Processing of Blood Specimens, Approved Guideline, NCCLS publication H18-A, Villanova, PA (1990).
6. National Committee for Clinical Laboratory Standards, Routine Urinalysis and Collection, Transportation and Preservation of Urine Specimens, Tentative Guideline, NCCLS publication GP16-T, Villanova, PA (1992).
7. Tietz, N. W., Clinical Guide to Laboratory Tests, 3rd Edition, W. B. Saunders, Philadelphia, PA (1995).
8. National Committee for Clinical Laboratory Standards, How to Define, Determine, and Utilize Reference Intervals in the Clinical Laboratory, Approved Guideline, NCCLS publication C28-A, Villanova, PA (1995).
9. Tietz, N. W., ed., Fundamentals of Clinical Chemistry, 3rd Edition, W. B. Saunders, Philadelphia, PA (1987).
10. Henry, J. B., Clinical Diagnosis and Management by Laboratory Methods, 18th Edition, W. B. Saunders Company, Philadelphia, PA (1991).
11. Young, D. S., Effects of Drugs on Clinical Laboratory Tests, 4th Edition, AACC Press, Washington, D. C. (1995).
12. Friedman, R. B., Young, D. S., Effects of Disease on Clinical Laboratory Tests, 3rd Edition, AACC Press, Washington, D.C. (1997).
13. Young, D. S., Effects of Preanalytical Variables on Clinical Laboratory Tests, 2nd Edition, AACC Press, Washington, D. C. (1997).
14. National Committee for Clinical Laboratory Standards, Method Comparison and Bias Estimation Using Patient Samples, Approved Guideline, NCCLS publication EP9-A, Villanova, PA (1995).
15. National Committee for Clinical Laboratory Standards, Precision Performance of Clinical Chemistry Devices, Tentative Guideline, 2nd Edition, NCCLS publication EP5-T2, Villanova, PA (1992).

 Beckman Coulter, Inc., 250 S. Kraemer Blvd., Brea, CA 92821