| **Glucose** |
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| **Purpose** | This procedure provides instructions for GLUCOSE ON ABBOTT INSTRUMENTATION. The glucose method is an *in vitro* diagnostic test for the quantitative measurement of glucose in human serum and plasma on the Abbott Architect c4000 or Abbott Alinity c automated chemistry analyzers, and in human body fluids: CSF, pericardial, peritoneal, and chest fluid. |
| **Policy Statements** | This procedure applies to all personnel responsible for operating the Abbott Architect c4000 or Abbott Alinity c at Children’s Minnesota Laboratory.  |
| **Principle** | Glucose is phosphorylated by hexokinase (HK) in the presence of adenosine triphosphate (ATP) and magnesium ions to produce glucose-6-phosphate (G-6-P) and adenosine diphosphate (ADP). Glucose-6-phosphate dehydrogenase (G-6-PDH) specifically oxidizes G-6-P to 6-phosphogluconate with the concurrent reduction of nicotinamide adenine dinucleotide (NAD) to nicotinamide adenine dinucleotide reduced (NADH). One micromole of NADH is produced for each micromole of glucose consumed. The NADH produced absorbs light at 340 nm and can be detected spectrophotometrically as an increased absorbance.Methodology: Enzymatic (Hexokinase/G-6-PDH) |
| **Clinical Significance** | Blood glucose determinations are the most frequently performed clinical chemistry laboratory procedures, commonly used as an aid in the diagnosis and treatment of diabetes. Elevated glucose levels (hyperglycemia) may also occur with pancreatic neoplasm/pancreatitis, hyperthyroidism, adrenal cortical hyperfunction, non-fasting specimens, recent or current IV infusions of glucose, stress states, Cushing’s disease, acromegaly, liver disease, and effects of many medications.Hypoglycemia has numerous causes including, excessive insulin therapy, various tumors, Addison’s disease, adrenal insufficiency, hypopituitarism, medication therapies, and liver damage.No claims are made regarding the significance or reference intervals for glucose in body fluids. |
| **Analyzer** | **Minneapolis: Abbott Alinity c (Sunquest method code: MALIC) and Minneapolis Alinity ci (Sunquest test code: MACC)****St. Paul: Abbott Architect c4000 (Sunquest method code: ARCH4), Abbott Alinity c (Sunquest method code: SALIC)** |
| **Sunquest Test Codes** | **FGLU**: Glucose, body fluid (performed on Minneapolis Alinity ci, MACC, only.)**CGL:** Glucose on spinal fluid. (MACC and SALIC only.)

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| Glucose, serum or plasma | GLUC |
| Glucose, CSF | **CGL** |
| Glucose, Random urine | **UGLR** |
| Glucose, Timed urine | **UGLQ** |
| Glucose, fasting | **GLF** |
| Glucose, 2 hour | **GT2** |
| Glucose, body fluid | **FGLU** |

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| **Specimen** | Sample: * Plasma (lithium or sodium heparin) preferred. Serum, SST, sodium fluoride, and potassium oxalate also acceptable. Refer to specimen collection procedures for collection of plasma and serum samples.
* Fasting Glucose: the ADA recommends an 8 hour fast, with nothing by mouth except water prior to collection.
* Glucose Tolerance Specimens: Refer to the Oral Glucose Tolerance Protocol for collection and timing of specimens.
* CSF: Glucose should be measured on the same sample used to report the cell count. A simultaneous blood specimen is needed for proper CSF glucose interpretation.
* Body fluid: Heparinized, non-viscous, sterile collection.

**Minimum sample volume:** 200 µL preferred, 150 µL minimum**Stability when separated from cells/gel:** RT / 7 days, 2-8 °C / 3 weeks, < -20°C / 8 monthsBody Fluid: Do not freeze. Store at refrigerated temperatures for 7 days.**Rejection criteria:** Unlabeled tube, sample type other than serum or plasma types listed above**Preparation:** 1. Whole blood specimens should be centrifuged following complete clot formation, according to Specimen Processing procedures prior to analysis.
2. Serum or plasma should be physically separated from cells as soon as possible with a maximum limit of two hours from the time of collection.
3. Specimens should be free of particulate matter.
4. Transfer serum or plasma to a properly labeled sendout tube. Short samples should be pipetted into an Abbott sample cup and nested on a sendout tube; any amount remaining after sampling should be pipetted into the sendout tube and tightly capped.
5. Architect and Alinity systems utilize a specimen level detect mechanism, so special racks specific to tube-type are not required.
6. Minimum labeling includes sample accession ID, and/ or patient name, medical record number, collection date and time.
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| **Reagents** | **Alinity c and Architect c4000:****Reagent Handling** Upon receipt, place reagent cartridges in an upright position for 1 hour before use to allow bubbles that may have formed to dissipate. If a reagent cartridge is dropped, place in an upright position for 1 hour before use to allow bubbles that may have formed to dissipate. Reagents are susceptible to the formation of foam and bubbles. Bubbles may interfere with the detection of the reagent level in the cartridge and cause insufficient reagent aspiration that may adversely affect results. Use a pipette to remove all bubbles prior to loading on the Alinity or Architect system.* Do not use reagents beyond the expiration date.
* Do not pool reagents within a kit or between kits.
* Do not use components from one lot with components from another lot.

**Alinity c:**Reagents may be stored on or off the system. If removed from the system, store reagents with new replacement caps in an upright position at 2 – 8°C. For reagents stored off the system, it is recommended that they be stored in their original trays or boxes to ensure they remain upright.**Alinity c:**

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| ***Product Description*** | ***Product Code*** | ***Stability*** |
| Abbott Alinity c Glucose ReagentCHC# 32627 | 07P55-20 | **Store at:** 2 – 8°C**Unopened:** Manufacturer’s printed expiration date**On-board: 30 days****Opened, off the analyzer (with clean caps):** Manufacturer’s printed expiration date. (Reagents may be stored on or off the system. The system tracks time onboard.) |
| Abbott Alinity c Multiconstituent CalibratorCHC# 32633 | 08P60-01 | **Store at:** 2 – 8°C**Unopened:** Manufacturer’s printed expiration date**On board expiration: 5 days when stored onboard.** The Alinity c tracks time on the system.**Opened expiration: 7 days** when opened and stored off the system. |

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|  | **Architect c4000:**

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| ***Product Description*** | ***Product Code*** | ***Stability*** |
| Abbott Architect Glucose ReagentCHC# 32549 | 03L82-21 | **Store at:** 2 – 8°C**Unopened:** Manufacturer’s printed expiration date.**On-board:** 30 Days |
| Abbott Architect Multiconstituent CalibratorCHC# 32557 | 01E65-05 | **Store at:** 2 – 8°C**Unopened:** Manufacturer’s printed expiration date**Opened:** 7 Days |

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| **Risk and Safety** |

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| **CAUTION:** For in vitro diagnostic use. This product requires the handling of human specimens. It is recommended that all human sourced materials be considered potentially infectious and be handled in accordance with the OSHA Standard on Bloodborne Pathogens. Appropriate Personal Protective Equipment (PPE) must be worn according to Children’s Minnesota Laboratory policies. Current SDSs are kept on the [Children’s StarNet](https://msdsmanagement.msdsonline.com/a07dc954-23d8-42a9-b591-ef5763cdfd33/ebinder/?nas=True) page.R1 Reagent: Contains sodium azide. Contact with acids liberates very toxic gas. Recap and dispose of in Alkaline waste stream. Multiconstituent Calibrator should be disposed of in Regulated Medical Waste (red trash). |

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| **Calibration** | **Alinity c** and **Architect c4000:**

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| Assay Range: | 5 - 800 mg/dL serum/plasma/CSF5 – 700 mg/dL Body Fluids |
| Reference Material: | Abbott Alinity Multiconstituent Calibrator |
| Suggested Calibration Levels: |  See lot-specific assay set point documentation |
| Calibration Scheme: | 2 levels, Linear data reduction method |
| Calibration Frequency: | 30 Days |
| AMR | AMR is verified twice annually using the Maine Standards GC1, Product # 1100ab, and Body Fluid product by running all applicable levels in triplicate. Assay results are submitted to Maine Standards for compilation and comparison to peers. Results are reviewed and approved by the Technical Specialist. Any questionable results are investigated and corrective actions documented.  |

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| **Quality Control** | **Alinity c and Architect c4000 for serum/plasma/body fluid QC:** Bio-Rad Liquichek™ Multiqual 1,2,3 Unassayed Chemistry Control Levels 1 & 3**Frequency:** Two levels each day**Stability:** Once thawed, opened, and stored tightly capped at 2 to 8°C, this product will be labeled with an expiration date equal to the shortest stability of the included analytes, which is **7 days.****Preparation**: This product should be treated the same as patient specimens and run in accordance with the instructions accompanying the instrument, kit, or reagent being used. * To thaw the product, allow it to stand at room temperature (18° to 25°C) until completely thawed but no longer than one (1) hour.
* After thawing, the product **MUST** be gently swirled and inverted several times to ensure homogeneity.
* For optimal analyte stability in the thawed state, promptly return to 2 to 8°C storage after each use and minimize the time at room temperature to no more than 20 minutes daily.
* **Before each use**, gently swirl the contents until homogeneous with no visible signs of precipitate.

**Alinity c: (MACC and SALIC only) for CSF QC:**Bio-Rad Liquichek™ Spinal Fluid Control, Levels 1 and 2**Frequency**: Two levels each day**Stability:** Liquid and ready to use. Once opened, and stored tightly capped at 2 to 8°C, this product will be labeled with an expiration date equal to the shortest stability of the included analytes, which is **30 days.****Preparation**: This product should be treated the same as patient specimens and run in accordance with the instructions accompanying the instrument, kit, or reagent being used. * Allow product to reach room temperature prior to use
* For optimal analyte stability, promptly return to 2 to 8°C storage after each use and minimize the time at room temperature to no more than 20 minutes daily.
* **Before each use**, gently swirl the contents.

**Acceptable ranges:** * Non-Bio-Rad controls will utilize manufacturer ranges and 2 SD Westgard rules.
* New lots of Bio-Rad controls should be run for 20 days in parallel with the current lot whenever possible prior to switching to the new lot.
* Refer to the Westgard Rules in Chemistry procedure (insert hyperlink) for current Westgard rules in place for each analyte.
* **Acceptable ranges are current in Unity Real Time only.** Quality Control results must be rejected in Sunquest when the results cross the interface.
* In the event of a QC failure, refer to the [Unity Real Time QC Review, General User](https://starnet.childrenshc.org/References/labsop/chem/quality/ch-2.17-unity-real-time-qc-review-general-user.pdf) and navigate to the QC Troubleshooting section.
* Do not load or release patients until QC is acceptable in Unity Real Time.
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| **Interferences** | **Alinity c and Architect c4000:** **Hemolysis, Icterus & Lipemia (HIL) Index Values apply to serum only:**

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At HIL levels at or above the specified cutoff value, append the appropriate comment AFTER visually confirming presence of interferent: -HP for “Hemolysis present, may affect results.” -BIN for “Bilirubin Interference”-LINT for “Lipid Interference” Interference studies were conducted by Abbott Diagnostics Division and effects were assessed by Dose Response and Paired Difference methods at the medical decision levels of the analyte. Interference is less than 9% at glucose concentration levels of approximately 90 mg/dL and 135 mg/dL for:* Hemoglobin: up to 2000 mg/dL
* Bilirubin: up to 60 mg/dL
* Triglycerides: up to 2000 mg/dL

Interferences from medication or endogenous substances may affect results.For accurate results, serum and plasma specimens should be free of fibrin, red blood cells, and other particulate matter. Serum specimens from patients receiving anticoagulant or thrombolytic therapy may contain fibrin due to incomplete clot formation.  |
|  | **Alinity c and Architect c4000:**  |
| **Reference Intervals** |

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| Age | Glucose |
| Premature newborns | 20 - 60 mg/dL |
| Neonates | 30 - 60 mg/dL |
| Full term 0 – 1 day | 40 - 60 mg/dL |
| 1 to 364 days | 50 - 80 mg/dL |
| 1 – 18 years | 60 - 100 mg/dL |
| 60 – 89 years | 82 - 115 mg/dL |
| >90 years | 75 – 121 mg/dL |
| **Fasting glucose:** < 100 mg/dL Impaired fasting glucose (IFG), a fasting glucose between 100 and 125 mg/dL is defined by the ADA as a category at risk for future diabetes and cardiovascular disease. Normal fasting plasma glucose is defined as <100 mg/dL

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| Test | **Reference range** |
| **CSF**: | 40-75 mg/dL or 60% of a concurrently measured plasma value |

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| **Critical Values** | **Plasma/Serum**: < 50 mg/dL or > 300 mg/dL.**CSF**: < 30 mg/dLCritical values must be called and documented according to the Critical Limit Test Value Policy. |
| **Limitations** | The instrument reporting system contains flags and comments to provide the user with information regarding instrument processing errors, instrument status information and potential errors in glucose results. Refer to the [Abbott Architect](https://starnet.childrenshc.org/References/labsop/chem/operator/abbott-architect-operations-manual.pdf) or [Alinity](https://starnet.childrenshc.org/References/labsop/chem/operator/alinity-ci-series-operations-manual.pdf) Operator’s Guides for the meaning of report flags and comments, and instructions for addressing them. Do not report results until a report containing flags and/or comments is resolved.For accurate results, serum and plasma specimens should be free of fibrin, red blood cells, and other particulate matter. Serum specimens from patients receiving anticoagulant or thrombolytic therapy may contain fibrin due to incomplete clot formation.  |
| **Dilutions** |

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| **Alinity c and Architect c4000:**  |
| Auto Dilution: | 1:5 |
| Maximum Manual Dilution: | Do not manually dilute |
| Diluent: | Onboard Saline |
| Manual Dilution: | Follow Abbott [Architect Operator’s Manual](https://starnet.childrenshc.org/References/labsop/chem/operator/abbott-architect-operations-manual.pdf) or [Alinity Operator’s Manual](https://starnet.childrenshc.org/References/labsop/chem/operator/alinity-ci-series-operations-manual.pdf) instructions for programming automated dilutions. The system will automatically calculate the concentration of the sample and report the result. If a diluted sample result is less than the lower value of the measuring interval of 5.0 mg/dL, do not report the result. Rerun and/or investigate for other possible causes of error. |

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| **Result Reporting** | **Alinity c and Architect c4000:** * Results between 50 – 300 mg/dL without error messages are released
* Results below 50 mg/dL and above 300 mg/dL but within the AMR must be called and documented as critical.
* Results <5.0 mg/dL without error messages are reported as < 5.0 mg/dL
* Results > 800 mg/dL should be diluted using the onboard automated 1:5 dilution. Release results without error messages following dilution.
* Results > 4000 mg/dL following automated dilution are reported as >4000 mg/dL.
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| **Specimen Storage** | Promptly stopper tested specimen and store upright in a specimen rack. Every 8 hours remove specimens to refrigerator/freezer storage. Samples are retained 7 days in specimen storage freezer. |
| **References** | 1. Jacobs & DeMott Laboratory Test Handbook, Lexi-Comp, Inc., Hudson, OH, 5th Edition, 2001
2. Architect Glucose Package Insert, Abbott Laboratories Diagnostics Division, Abbott Park, IL 60064, May 2017.
3. Alinity Glucose Package Insert, Abbott Laboratories Diagnostics Division, Abbott Park, IL 60064, February 2018.
4. Alinity c Multiconstituent Calibrator Package Insert, Abbott Laboratories Diagnostics Division, Abbott Park, IL 60064, December 2017.
5. Architect Multiconstituent Calibrator Package Insert, Abbott Laboratories Diagnostics Division, Abbott Park, IL 60064, August 2017.
6. Bio-Rad Liquichek Multiqual 1,2,3 Unassayed Chemistry Control Product Insert, Bio-Rad Laboratories, Irvine, CA 92618
7. Bio-Rad Liquichek Spinal Fluid Control Insert, Bio-Rad Laboratories, Bio-Rad Laboratories, Irvine, CA 92618
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| **Historical Record** | **Version** | **Written/Revised by:** | **Effective Date:** | **Summary of Revisions** |
| 1 | Erin Bartos | 10/15/2019 | New Procedure for Abbott analyzers |
|  | Elauteria Earnhardt | April 23, 2020 | Added St Paul Alinity c analyzer |
|  | 3 | Erin Bartos | 10/28/2020 | Added Alinity ci Mpls, Added HIL box, added CSF and body fluid, changed QC, updated AMR for body fluids. Added ref ranges and critical for CSF. |