ACCU-CHEK® and AccuData® Systems Evaluation Protocol

Accuracy Study Protocol for Glucose Meter Evaluations

Purpose of Protocol

This protocol is a guidance tool for performing accuracy studies and is recommended for use with the Roche ACCU-CHEK and AccuData glucose monitoring systems.[1] If you wish to include other manufacturers' systems in your studies you should contact each vendor to obtain their recommended evaluation protocols.[2]

Introduction

Accuracy, also known as "trueness," is the closeness of agreement between a test result and an accepted reference value.[3,4] Accuracy studies on ACCU-CHEK and AccuData glucose monitoring systems are conducted by performing whole blood tests on the meter system and then testing plasma or serum from the same (or concurrently collected) samples using your reference chemistry analyzer. A variety of statistical indicators can be employed to assess the outcome of a study, but the most common indicators of accuracy are the correlation coefficient (r), slope, yintercept, standard error, and bias analysis.

Factors to Consider

1. An appropriate reference method for your accuracy study is the primary system used in your laboratory to perform routine and stat glucose testing. The accuracy of the reference method should be demonstrable through comparative studies with a definitive method or through traceability of standard reference materials.[5,6]
2. A minimum of 20 samples – optimally 40 samples – should be analyzed in your study.[7,8] Every individual sample has a unique matrix causing it to exhibit a particular correlation to your reference analyzer. It is important to include samples from a balanced variety of subjects that represent your typical patient population in your study in order to prevent matrix-based biases from skewing your study outcome. Healthy staff volunteers may be used as a supplemental source of samples, but they are not representative of your patient population and should not be used as a majority source of samples.
3. Glucose values that are well distributed throughout the analytical measurement range (AMR) of the system should be included in the study. Approximately 50% of the glucose values should be outside of the normal range.[9] The validity of statistical analysis of your study data is dependent upon a good distribution of data points throughout the AMR. The Roche *"Glucose Spiking Protocol for Glucose Meter Evaluations"* provides instructions for spiking whole blood samples to obtain high and low glucose levels as needed and when appropriate.
4. Pooled whole blood cannot be used due to potential ABO blood type incompatibilities.
5. The timing of tests and study logistics vary somewhat based on the types of samples (capillary, venous, arterial, neonate) you are including in your studies. Separate procedures for studies using the various sample types are included in this protocol to help you manage timing and logistics.
6. The **Accuracy Study Data Collection Forms Appendix** at the end of this protocol will help you to establish the design of your study and plan for the number of meters, quantity of strips and types of samples used in the study.

Sample Requirements

Refer to the manufacturers' package inserts for the ACCU-CHEK test strip you are using and for your chemistry analyzer's glucose reagent for specific information on what types of blood samples (venous, arterial, capillary or neonate) and anticoagulants are acceptable for use with each system. Use only sample types that are allowed in the package inserts in your studies. ***Do not centrifuge or refrigerate samples*** prior to meter testing.

Safety Considerations

Follow all of your internally established biohazard / bloodborne pathogen safety procedures when handling and disposing of biological materials and sharps.

Accuracy Study Procedure Using Venous or Arterial Blood

In this study, you will test venous and/or arterial whole blood on ACCU-CHEK or AccuData meters. You will then centrifuge and test the plasma from the same samples on your reference analyzer. If samples are obtained from an arterial or venous line, follow your established protocol to clear line of fluids and medications before obtaining samples. Samples used in this study should be tested within six hours of collection.

Materials

- ACCU-CHEK or AccuData meter(s)
- ACCU-CHEK test strips
- ACCU-CHEK quality control solutions
- Reference analyzer and supplies
- Venous or arterial whole blood samples collected in an appropriate anticoagulant
- Appropriate personal protective equipment
- Test tube racks
- Biohazard container
- Disposable transfer pipette(s)

Procedure

1. Perform low and high quality control testing on all meters and on the chemistry analyzer used in the study. Proceed with testing only if all control results are within range.
2. Select a venous or arterial whole blood sample for testing and invert the sample gently to mix.
3. Test the sample on the ACCU-CHEK or AccuData glucose meter(s) by applying the blood to the test strip using a disposable transfer pipette.
4. Within 30 minutes of meter testing, centrifuge the sample and test the plasma on a laboratory reference analyzer.
5. Repeat steps 2–4 for all samples in the study. Batches of 4 – 8 samples may be processed together as long as not more than 30 minutes elapses between the time the first sample of the batch was tested on the meter(s) and the batch of samples is centrifuged for chemistry.
6. Utilize the Roche *"Glucose Spiking Protocol for Glucose Meter Evaluations"* to obtain high and low glucose levels as needed to ensure a good distribution of values in your study.
7. Record each result in the appropriate space on the selected **Accuracy Study Data Collection Form** provided in the appendix.

Accuracy Study Procedure Using Capillary Fingerstick Blood

In this study, you will be testing capillary whole blood collected by fingerstick on ACCU-CHEK or AccuData meter(s). Within 10 minutes of meter fingerstick testing, you will collect a venous sample, centrifuge the venous sample and test the plasma on your chemistry analyzer. Since fingerstick glucose levels can be significantly higher than venous glucose levels in the non-fasting state, all subjects included in this study must be fasting.[10]

Materials

- ACCU-CHEK or AccuData meter(s)
- ACCU-CHEK test strips
- ACCU-CHEK quality control solutions
- Reference analyzer and supplies
- Appropriate personal protective equipment
- Appropriate fingerstick sample collection supplies
- Appropriate venous sample collection supplies
- Test tube racks
- Biohazard container

Procedure

1. Perform low and high quality control testing on all meters and on the chemistry analyzer used in the study. Proceed with testing only if all control results are within range
2. Following your internally established fingerstick procedure, obtain a **fasting** fingerstick capillary sample and test on the ACCU-CHEK or AccuData glucose monitoring system.
3. Immediately (within 10 minutes) collect a venous blood sample in a tube appropriate for testing on your laboratory chemistry analyzer. If the venous sample is obtained from a line, follow your established protocol to clear the line of fluids and medications before obtaining the sample. Do not collect a venous sample upstream from an infusing IV catheter.
4. Within 30 minutes of collection, centrifuge the venous sample and test the plasma or serum on your laboratory chemistry analyzer.
5. Repeat steps 1–4 for all samples in the study.
6. Record each result.

Accuracy Study Procedure Using Neonate Blood

In this study, you will be collecting whole blood samples from neonates and testing them on ACCU-CHEK or AccuData meter(s). Within 10 minutes of each meter test, you will collect a sample to centrifuge for plasma testing on your chemistry analyzer. Heelstick capillary, venous, arterial or cord blood samples may be used. If samples are obtained from an arterial or venous line, follow your approved protocol to clear the line of fluids and medications before performing meter tests or obtaining lab samples.

Special Factors to Consider

1. Neonate testing is not appropriate for all ACCU-CHEK glucose monitoring systems. Refer to the ACCUCHEK test strip package insert for the system you wish to evaluate to confirm that neonate blood is an acceptable sample type.
2. In order to minimize blood loss from infants, you can attempt to arrange for your study testing to coincide with lab testing that has been formally ordered on infants.
3. Due to high hematocrits and the high content of nucleated and immature red and white blood cells in neonate blood, glycolysis occurs rapidly in neonate samples.[11][12] Therefore, it is critical to centrifuge your lab samples within 15 minutes of meter testing. Serum or plasma separator micro-collection tubes are ideal for separating the plasma from cells as quickly as possible. You may ice the lab sample to inhibit glycolysis as long as this does not conflict with any other testing that you may need to perform on the sample.[13]
4. Managing the timing between meter and lab testing can be challenging if the nursery is some distance from the lab. Two logistical types of procedures are offered below to help you manage your timing. The **Primary Procedure** allows for meter testing at the infant bedside and assumes that you are able to deliver and centrifuge your lab samples within 15 minutes of collection. The **Alternate Procedure** allows for anticoagulated micro-collection samples to be collected at the bedside, delivered to the lab and then both meter and lab testing are performed in the lab from the micro-collection tube sample. The alternate procedure will be helpful when you wish to minimize activity and the presence of personnel in the nursery or cannot deliver and centrifuge the lab samples within 15 minutes of collection.

Primary Procedure (meter tests performed at infant bedside)

1. Perform low and high quality control testing on all meters and on the chemistry analyzer used in the study. Proceed with testing only if all control results are within range
2. Obtain a whole blood neonate sample (heelstick, venous, arterial or cord blood) and test on the ACCUCHEK or AccuData glucose meter(s).
3. Immediately collect a neonate blood sample of appropriate type and volume for plasma testing on your chemistry analyzer.
4. Within 15 minutes of collection, centrifuge the lab sample and test the plasma or serum on your laboratory chemistry analyzer.
5. Repeat steps 1–4 for all samples in the study.
6. Record each result in the appropriate space on the selected **Accuracy Study Data Collection Form** provided in the appendix.

Alternate Procedure (meter tests performed in lab)

1. Perform low and high quality control testing on all meters and on the chemistry analyzer used in the study. Proceed with testing only if all control results are within range
2. Obtain an anticoagulated neonate sample (heelstick, venous, arterial or cord blood) of appropriate volume for plasma testing on your chemistry analyzer and deliver the sample to the lab as quickly as possible.
3. Gently invert several times to mix the sample and then test the sample on the ACCU-CHEK or AccuData glucose meter(s) by applying the blood to the test strip using a disposable transfer pipette.
4. Within 15 minutes of meter testing, centrifuge the lab sample and test the plasma on your laboratory chemistry analyzer.
5. Repeat steps 1–4 for all samples in the study.
6. Record each result in the appropriate space on the selected **Accuracy Study Data Collection Form** provided in the appendix.

Analysis of Accuracy Study Results

General Considerations

There are numerous ways to analyze the results of your study. All data analysis is based on pairing individual meter results with corresponding reference analyzer results and calculating the difference between the meter and the reference analyzer. Common options are to perform linear regression analysis and bias analysis. All results should be included in your results analysis unless you know of a specific reason to exclude a particular result, such as known or strongly suspected clerical, processing or sequencing errors.

Calculations

Linear Regression Analysis

Regression analysis can be performed using any of a number of statistical analysis software packages. Perform a linear regression of the data according to the software instructions, placing the reference data on the x-axis and the monitor/meter data on the y-axis. Calculate the correlation coefficient (r), slope and Y intercept.

Bias Analysis:

1. For reference analyzer glucose values less than 75 mg/dL, subtract the reference value from the monitor value.

   Meter Value (mg/dL) – Reference Value (mg/dL) = Difference (mg/dL)

2. For reference analyzer glucose values greater than or equal to 75 mg/dL, subtract the reference value from the monitor value. Divide the difference by the reference value. Multiply the result by 100 to obtain the % difference:

$$\left(\frac{MeterValue(mg/dL) - ReferenceValue(mg/dL)}{ReferenceValue(mg/dL)}\right) \times 100 = \%Difference$$

Examples:

1. Glucose value < 75 mg/dL:
   Reference = 67 mg/dL ACCU-CHEK glucose test system = 66 mg/dL:

   67 mg/dL – 66 mg/dL = 1 mg/dL

2. Glucose value ≥ 75 mg/dL:
   Reference = 380 mg/dL ACCU-CHEK glucose test system = 392 mg/dL

$$\left(\frac{392mg/dL - 380mg/dL}{380mg/dL}\right) \times 100 = 3\%Difference$$

Interpretation of Results

Each institution should determine its own acceptability criteria. The validity of your statistics and the appropriate interpretation of your results analysis are dependent upon a variety of factors, such as the number and matrix of samples used in your study, the distribution of the results throughout the AMR of the meter system, and the calibration of the reference analyzer. Carefully consider these factors when interpreting your results analysis. Prominent references for acceptable correlation state that 95% of the individual results from the POC glucose monitoring system should agree within ± 15 mg/dL of the reference analyzer values at glucose concentrations below 75 mg/dL and within ± 20% of the laboratory analyzer values at concentrations at or above 75 mg/dL.[14][15]

References

[1] All ACCU-CHEK and AccuData products must be used according to their labeling. All evaluation protocols are supplemental to proper use as described in each system's packaging.
[2] CLSI C30A-2; Point of Care Glucose Testing in Acute and Chronic Care Facilities; Approved Guideline-Second Edition; 2002; Item 6.3.2.1.2; Page 7.
[3] ISO 15197, *In Vitro* diagnostic test systems – Requirements for blood glucose monitoring systems for self-testing in managing diabetes mellitus, 2003, Sections 3.1, page 2.
[4] CLSI EP15-A2, User Verification of Performance for Precision and Trueness; Approved Edition, 2nd Edition, 2006, Section 9, page 10.
[5] Basic Method Validation, 2nd Edition; James O. Westgard, Ph.D.; Copyright 2003; Westgard QC, Inc.; Madison, WI; page 112.
[6] CLSI EP9-A2, Method Comparison and Bias Estimation Using Patient Samples; Approved Guidelines – 2nd Edition, Section 3.2, page 4.
[7] CLSI EP15-A2, User Verification of Performance for Precision and Trueness; Approved Edition, 2nd Edition, 2006, Section 9.1, page 12.
[8] Basic Method Validation, 2nd Edition; James O. Westgard, Ph.D.; Copyright 2003; Westgard QC, Inc.; Madison, WI; page 113.
[9] CLSI EP9-A2, Method Comparison and Bias Estimation Using Patient Samples; Approved Guidelines – 2nd Edition, Section 1.1, page 1.
[10] *Tietz Textbook of Clinical Chemistry*, 2nd Edition; Carl A. Burtis and Edward R. Ashwood, Editors; 1994; Page 959.
[11] CLSI C30-A2, Point-of-Care Blood Glucose Testing in Acute and Chronic Care Facilities; Approved Guideline – Second Edition; September 2002; Item 6.3.1; page 10.
[12] CLSI H18-A3; Procedures for the Handling and Processing of Blood Specimens; Approved Guideline – Third Edition; November 2004; Item 6.1.1.4; page 5.
[13] CLSI H18-A3; Procedures for the Handling and Processing of Blood Specimens; Approved Guideline – Third Edition; November 2004; Item 6.1.1.3; page 5.
[14] CLSI C30-A2, Point-of-Care Blood Glucose Testing in Acute and Chronic Care Facilities; Approved Guideline – Second Edition; September 2002; Item 6.3.1; page 10.
[15] ISO 15197, *In Vitro* diagnostic test systems – Requirements for blood-glucose monitoring systems for self-testing in managing diabetes mellitus, 2003, Section 3.1, page 2.

Appendix

ACCU-CHEK Evaluation Protocol
Accuracy Study Data Collection Form

Hospital Name: _____ Date of Study: _____
Analyzer Type: _____ Performed by: _____
Anticoagulant: _____

Meter Type						
Sample ID	**Lab Result**	Meter Serial # _____	Meter Serial # _____	Meter Serial # _____	Meter Serial # _____	Meter Serial # _____
Low QC	Range:					
High QC	Range:					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

ACCU-CHEK Strip Lot: _____ Expiration: _____
ACCU-CHEK Control Lot: _____ Expiration: _____

ACCU-CHEK Evaluation Protocol
Accuracy Study Data Collection Form

Hospital Name: _____ Date of Study: _____
Analyzer Type: _____ Performed by: _____
Anticoagulant: _____

Sample ID	Lab Result	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						

ACCU-CHEK Strip Lot: _____ Expiration: _____
ACCU-CHEK Control Lot: _____ Expiration: _____

ACCU-CHEK Evaluation Protocol

Neonate Accuracy Study Sample Collection Form

Sample ID		**Sample Type**
Bedside Meter Glucose Time: Date: Initials:	**Lab Meter Glucose** Time: Date: Initials:	**Lab Analyzer Glucose** Time: Date: Initials:
Comments:		

Neonate Accuracy Study Sample Collection Form

Sample ID		**Sample Type**
Bedside Meter Glucose Time: Date: Initials:	**Lab Meter Glucose** Time: Date: Initials:	**Lab Analyzer Glucose** Time: Date: Initials:
Comments:		

Neonate Accuracy Study Sample Collection Form

Sample ID		**Sample Type**
Bedside Meter Glucose Time: Date: Initials:	**Lab Meter Glucose** Time: Date: Initials:	**Lab Analyzer Glucose** Time: Date: Initials:
Comments:		

ACCU-CHEK Evaluation Protocol
Accuracy Study Data Collection Form

Hospital Name: _____ Date of Study: _____

Analyzer Type: _____ Performed by: _____

Anticoagulant: _____

Meter Type:											
Sample ID	**Lab Result**	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #
Low QC	Range:										
High QC	Range:										
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											

Strip Lot: _____ Expiration: _____

Control Lot: _____ Expiration: _____

ACCU-CHEK Evaluation Protocol
Accuracy Study Data Collection Form

Hospital Name: _____ Date of Study: _____

Analyzer Type: _____ Performed by: _____

Anticoagulant: _____

Meter Type:											
Sample ID	**Lab Result**	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #	Meter Serial #
Low QC	Range:										
High QC	Range:										
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

Strip Lot: _____ Expiration: _____

Control Lot: _____ Expiration: _____

ACCU-CHEK Evaluation Protocol
Fingerstick Accuracy Study Data Collection Form

Hospital Name: _____
Anticoagulant: _____
Lab Analyzer: _____

Date of Study: _____
Performed by: _____

Meter Type and Serial Number								
Date	Sample ID	Meter Fingerstick Glucose, mg/dL	Meter Fingerstick Test Time	Venous Meter Glucose, mg/dL	Venous Meter Test Time	Lab Venous Plasma/ Serum Glucose, mg/dL	Lab Test Time	Comments

Strip Lot: _____ Expiration: _____
Control Lot: _____ Expiration: _____

ACCU-CHEK Evaluation Protocol
Neonate Accuracy Study Data Collection Form

Hospital Name: _____ Date of Study: _____

Anticoagulant: _____ Performed by: _____

Lab Analyzer: _____

Meter Type and Serial Number								
Date	Sample ID	Meter Fingerstick Glucose, mg/dL	Meter Fingerstick Test Time	Venous Meter Glucose, mg/dL	Venous Meter Test Time	Lab Venous Plasma/ Serum Glucose, mg/dL	Lab Test Time	Comments

Strip Lot: _____ Expiration: _____

Control Lot: _____ Expiration: _____

General Information

This document is published by the Roche Diagnostics Commercial Education department.
Questions or comments regarding the contents of this guide can be directed to:

Roche Diagnostics
Commercial Education Department
9115 Hague Road
P.O. Box 50457
Indianapolis, IN 46250-0457
USA

This document is only available on the www.poc.roche.com website.

4481-00-1112

Revision History

Revised pages for this manual are provided by Roche Diagnostics when necessary. No part of this publication may be reproduced in any form or by any means without prior written permission.

Publication Reference Number	Date	Pages Affected
4481-00-1112	**November 2012**	**New document**