TRAINING UPDATE

Lab Location:	SGAH and WAH	**Date Implemented:**	8.21.13
Department:	Blood Bank	**Due Date:**	**9.4.13 (firm deadline due to RQI response)**

DESCRIPTION OF PROCEDURE REVISION

Name of procedure:
Crossmatch
Description of change(s):

1. When you perform a crossmatch, pull the specimen and compare the specimen label to the computer. Ensure the following match EXACTLY.
    a. Patient's full name
    b. Patient's medical record number
    c. Patient's blood bank armband number

2. When resulting a crossmatch, DO NOT enter the "OK to transfuse" in the TS field until all crossmatch testing is complete.

3. When you have a positive immediate spin crossmatch due to a strong cold antibody:
    a. Allow the donor cells and patient plasma to warm to room temperature then repeat testing through AHG phase using LISS tube methodology.
    b. Perform an immediate spin antibody screen using patient plasma to determine if a strong cold antibody is present. Reflex to an immediate spin panel if indicated.
    c. Interpret the crossmatch as compatible if ALL of the following conditions have been met:
        i. A cold antibody has been identified
        ii. The AHG crossmatch in LISS tube is negative (compatible)
        iii. The ABO and Rh of both the patient and unit have been verified and are compatible

4. Added Appendix G to outline how to result a least incompatible crossmatch due to a warm autoantibody.
    a. Order and enter ALL crossmatches performed (Echo, LISS, prewarm, etc).
    b. Interpret each crossmatch as compatible, incompatible, or least incompatible.
    c. Do not enter the TS field with "OK to Transfuse" until all crossmatches have been performed and resulted. This is the field that generates the pink unit tag.
    d. When the QA failure message flags (for the least incompatible XM) answer it using mnemonic "LIWAA" which expands to "least incompatible due to WAA."

Technical SOP

Title	**Crossmatch**	
Prepared by	Stephanie Codina	Date: 1/25/2012
Owner	Stephanie Codina	Date: 1/25/2012

Laboratory Approval	**Local Effective Date:**	
Print Name and Title	**Signature**	**Date**
Refer to the electronic signature page for approval and approval dates.		

Review		
Print Name	**Signature**	**Date**

TABLE OF CONTENTS

1. TEST INFORMATION

Assay	Method/Instrument	Order Code	Local Code
Crossmatch	Tube	N/A	N/A

Synonyms/Abbreviations
Compatibility test, Xmatch, XM, XMAHG, XMECHO

Department
Blood Bank

2. ANALYTICAL PRINCIPLE

A test with recipient's plasma and donor red cells is included in pre-transfusion testing to aid in the selection of blood components that, when transfused, will have acceptable survival and will not cause clinically significant destruction of the recipient's own red cells.

3. SPECIMEN REQUIREMENTS

3.1 Patient Preparation

Component	Special Notations
Fasting/Special Diets	N/A
Specimen Collection and/or Timing	N/A
Special Collection Procedures	N/A
Labeling	Patient identification must be confirmed and blood bank armband system utilized. Refer to procedure "Sample Specifications for Blood Bank Testing" for details.

3.2 Specimen Type & Handling

Criteria		
Type -Preferred **-Other Acceptable**	Plasma (EDTA) Heparin tube or clotted sample in tube w/out serum separator gel	
Collection Container	Lavender top tube, dark green top tube, or red top tube (without serum separator).	
Volume - Optimum **- Minimum**	10ml 2ml	
Transport Container and Temperature	Same as above, at room temperature	
Stability & Storage Requirements	Room Temperature:	24 hours
	Refrigerated:	EDTA samples ≤7 days unless approved by pathologist Clotted samples <7 days
	Frozen:	Unacceptable
Timing Considerations	Test as soon as possible following collection	
Unacceptable Specimens & Actions to Take	Frozen, Incomplete or incorrect labeling – refer to procedure "Sample Specifications for Blood Bank Testing" for details.	
Compromising Physical Characteristics	Refer to section 14.	
Other Considerations	None	

4. REAGENTS

Refer to the Material Safety Data Sheet (MSDS) supplied with the reagents for complete safety hazards. Refer to the section in this procedure covering "SAFETY" for additional information.

4.1 Reagent Summary

Reagents / Kits	Supplier & Catalog Number
Capture-R Select plates	Immucor, 6446 or equivalent
Capture LISS	Immucor, 6420 or equivalent
Capture-R Indicator Cells	Immucor, 6428 or equivalent
pHix	Immucor, 5070 or equivalent
Isotonic Saline, certified blood bank	Fisher, 23535435 or 23062125 or equivalent
ImmuAdd (LISS)	Immucor, 2008 or equivalent
Anti-IgG	Immucor, 409210 or equivalent

4.2 Reagent Preparation and Storage

NOTES: Date and initial all reagents upon opening. Each container must be labeled with (1) substance name, (2) lot number, (3) date of preparation, (4) expiration date, (5) initials of tech, (6) any special storage instructions; check for visible signs of degradation.
Refer to the Material Safety Data Sheet (MSDS) for a complete description of hazards. If a specific hazard is present, it will be noted in this procedure when the hazard is first encountered in a procedural step.

Reagent	Capture-R Select Plates
Container	Pack containing a tray of strips
Storage	1-30°C
Stability	Stable until manufacturer's expiration date as long as humidity indicator is acceptable.
Preparation	Ready to use.

Reagent	Capture-R Indicator Cells
Container	11.5 mL bottle
Storage	1-10°C
Stability	Stable for 24 hours after the addition of a stir ball or for manufacturer's expiration date (whichever is sooner).
Preparation	Add a stirball prior to loading on the Galileo Echo.

Reagent	Capture LISS
Container	11.5 ml
Storage	1-10°C
Stability	Stable until manufacturer's expiration date.
Preparation	Ready to use as supplied.

Reagent	ImmuAdd, Anti-IgG
Container	10 mL
Storage	1-10°C
Stability	Stable until manufacturer's expiration date.
Preparation	Ready to use as supplied.

Reagent	pHix
Container	200 mL bottle
Storage	18-30°C
Stability	Stable until expiration date on bottle.
Preparation	Ready to use. Concentrate is added to saline to create PBS.

Reagent	Isontonic Saline
Container	20L or 10L container
Storage	18-30°C
Stability	Stable until expiration date on container until opened. Stable for 30 days once opened and after pHix is added.
Preparation	pHix is added prior to use. pH must be between 6.5-7.5 after pHix is added.

5. CALIBRATORS/STANDARDS

N/A

6. QUALITY CONTROL

6.1 Controls Used

Controls	Supplier and Catalog Number
DAT Positive Cell	Immucor, 66122 or equivalent
Coomb's Control Cells (AKA Check Cells)	Immucor, 2225 or equivalent

6.2 Control Preparation and Storage

NOTE: Date and initial all controls upon opening. Each container should be labeled with (1) substance name, (2) lot number, (3) date of preparation, (4) expiration date, (5) initials of tech, and (6) any special storage instructions; check for visible signs of degradation.
Refer to the QC control kit insert sheet for preparation, storage and handling instructions.

6.3 Frequency

Echo quality control is run daily. Specifications for quality control are outlined in procedure, "Echo Quality Control."

QC for manual testing is performed on each day of use. Specifications are outlined in procedure, "Daily Reagent Quality Control."

6.4 Tolerance Limits

A. Quality control values must be within acceptable limits before reporting patient results.
B. Reject the run/result(s) if controls exceed acceptable limits.
C. Take action to correct the problems that led to unsatisfactory QC result and document these actions. Problem solving techniques include: reviewing maintenance procedures, checking control material and reagent deterioration, pipetting technique, and verifying equipment performance necessary in order to correct any systemic problem that may exist. If all reagent and instrument checks appear normal, controls and patient specimens must be repeated. Notify a supervisor or designee if controls remain out of range. **Do not report patient results until problems are resolved and controls are acceptable.**
D. If applicable, reanalyze patient results in the failed run or since the last acceptable run to determine whether the patient values are accurate and reliable.
E. All failed runs and/or out of limit controls must be documented.

6.5 Review Patient Data

N/A

6.6 Documentation

N/A

6.7 Quality Assurance Program

Participation in CAP proficiency testing.

7. EQUIPMENT and SUPPLIES

7.1 Assay Platform

Echo or manual LISS testing

7.2 Equipment

Calibrated serofuge
37C heat block
Cell washer
Timer

7.3 Supplies

Disposable pipettes
Phosphate Buffered Solution (PBS)

8. PROCEDURE

NOTE: For all procedures involving specimens, buttoned lab coats, gloves, and face protection are required minimum personal protective equipment. Report all accidents to your supervisor.

The package insert for a new lot of kits must be reviewed for any changes before the kit is used. A current Package Insert is included in the appropriate notebook/file.

8.1 Preparation for Testing

Step	Action
1	Ensure the patient has an order for crossmatch and/or transfusion. A. BOTH a written and computer order are required when Cerner is used to document the transfusion. The transfuse order opens the nursing fields required for data entry into the electronic medical record. a. Orders will cross into the LIS with the following mnemonics: i. TRRC = Transfuse red cell for all patients EXCEPT neonates ii. TRCNEO = Transfuse neonatal red cell iii. TWBNEO = Transfuse neonatal reconstituted whole blood

Step	Action
	b. TRRC orders are handled in the following manner: i. Receive the TRRC order and result the BCOM field with the mnemonic "ADTS" which translates to "Added to T&S." ii. Allocate the red cells to the recipient's T&S order. B. A written Transfusion Order form must be faxed to the blood bank prior to crossmatch and transfusion. Verbal orders will be documented on the "Telephone Order Log." Refer to procedure, "Blood Bank Verbal Product Orders." a. Verbal orders are accepted from the operating room (this does not include pre-op or PACU). b. Verbal orders are accepted when the patient's condition is unstable and patient care may be compromised without a verbal order.
2	Determine whether the patient has had the appropriate testing performed. A. The patient must have a current T&S specimen. a. Notify the patient care area if a T&S is needed. b. The T&S specimen can be ordered without physician/LIP orders when the patient has an order for crossmatch or transfusion. B. The patient must have at least 2 ABO/Rh determinations on file. a. Order an ABO Retype specimen to be collected STAT if the patient does not have 2 separate ABO/Rh determinations on file. b. Refer to procedure, "Confirmation of Patient's Blood Type (ABO Recheck)." c. Group O red cells will be crossmatched if the patient needs transfusion prior to completion of an ABO retype specimen. An emergency release form is not necessary.
3	Determine whether the patient has autologous or directed-donor blood products available per procedure, "Patient History Check." A. Units are always crossmatched and issued in the following order: 1. Autologous 2. Directed Donor 3. Homologous (Inventory) B. If a patient has autologous units available, refer to procedure, "Autologous Unit Management."
4	Retrieve the patient's T&S specimen, if stored. Verify that the specimen is labeled for transfusion per procedure, "Sample Specifications for Blood Bank Testing." Compare the specimen label to the data entry fields of the T&S specimen to ensure the following match exactly: A. Name B. Medical record number C. Blood bank number

Step	Action
5	Obtain units that meet the patient's transfusion criteria. The following should be considered: A. Blood type (Refer to Appendix A) B. Special transfusion attributes (irradiated, CMV-seronegative, etc) C. Antigen-negative units, if applicable (Refer to Appendix B) Units with shorter expiration dates are generally crossmatched first.

8.2 Immediate Spin Crossmatch

Note: A tech may only crossmatch one patient sample at a time. In extreme circumstances or when staffed with a single tech, multiple patient samples may be crossmatched provided each specimen is placed in a separate rack during testing.

Step	Action
1	Allocate each unit to be crossmatched in the LIS. Refer to Appendix C. If the LIS is down, prepare a downtime sheet for testing and document the full unit number of each unit number to be tested.
2	Prepare the donor red cells for testing. A. Label a clean test tube with the full unit number. Use of a unit label from the back of the unit is preferred. B. Remove an integrally attached segment from the unit. C. Place a segment piercing device on the top of the properly labeled tube. D. Cut the segment and drain some of the red cells into the correctly labeled test tube. E. Add saline to make a 3-5% red cell suspension. Refer to procedure, "Preparing a 2-4% Cell Suspension for Patient Testing." F. Return the unit(s) to the refrigerator.
3	Label 1 test tube per unit to be crossmatched. At a minimum, each test tube should contain: A. The recipient's first and last initial or the first 3 letters of the recipient's last name. B. The last 3 digits of the unit number. Refer to procedure, "Sample Specifications for Blood Bank Testing."
4	A. Place the red cell suspensions in the order in which they appear in the LIS system. B. Place each empty labeled test tube inline with the labeled test tube containing the red cell suspension for the same unit.
5	Place 2 drops of patient plasma into each labeled crossmatch tube.

Step	Action
6	Add 1 drop of each donor cell suspension to the corresponding crossmatch tube.
7	Gently mix each tube.
8	Visually observe each tube for appearance and volume.
9	Immediately serofuge each tube for the saline time listed on the serofuge (generally 15 seconds).
10	Remove tubes from the serofuge one at a time and: A. Check for hemolysis. B. Resuspend gently using an agglutination viewer. C. Read macroscopically for agglutination. D. Verify that the patient and unit identification on each tube matches the patient and unit identifiers in the LIS. Discard tubes and start over if a discrepancy exists. E. Immediately record results in the LIS or document on a downtime testing form.

8.3 AHG Crossmatch on the Galileo Echo

Note: You must perform an immediate spin crossmatch in addition to an Echo crossmatch to rule out ABO incompatibility.

Echo crossmatching is used as the primary method for AHG crossmatching. LISS crossmatching is used when the Echo is out of service or when a patient has antibody issues that are exacerbated on the Echo.

Step	Action
1	Bring the recipient specimen to room temperature (18-30°C).
2	Prepare the donor red cells for testing. A. Label a clean test tube with the full unit number. Use of a barcoded unit label from the back of the unit is preferred. B. Remove 1-2 integrally attached segments from the unit. C. Place a segment piercing device on the top of the properly labeled tube. D. Cut the segment and drain some of the red cells into the correctly labeled test tube. E. Serofuge the red cells for 1-2 minutes to pack them. A minimum of 250 µL of red cells are needed for crossmatch testing. F. Return the unit(s) to the refrigerator.
3	Perform crossmatch testing as outlined in procedure, "Galileo Echo Testing Patient Samples."

8.4 AHG Crossmatch by Manual Tube Methodology

Note: This type of crossmatch is not routinely performed.
A LISS crossmatch should only be used if the recipient's plasma cannot be tested by the primary method. This includes when the patient has a non-specific cold antibody that causes positive reactions using Capture methodology.

Step	Action
Note: Steps 1-5 can be performed simultaneously with the Immediate Spin Crossmatch procedure.	
1	Prepare the donor red cells for testing. A. Label a clean test tube with the full unit number. Use of a unit label from the back of the unit is preferred. B. Remove an integrally attached segment from the unit. C. Place a segment piercing device on the top of the properly labeled tube. D. Cut the segment and drain some of the red cells into the correctly labeled test tube. E. Add saline to make a 3-5% red cell suspension. Refer to procedure, "Preparing a 2-4% Cell Suspension for Patient Testing." F. Return the unit(s) to the refrigerator.
2	Label 1 test tube per unit to be crossmatched. At a minimum, each test tube should contain: A. The recipient's first and last initial or the first 3 letters of the recipient's last name. B. The last 3 digits of the unit number. Refer to procedure, "Sample Specifications for Blood Bank Testing."
3	A. Place the red cell suspensions in the order in which they appear in the LIS system. B. Place each empty labeled test tube inline with the labeled test tube containing the red cell suspension for the same unit.
4	Place 2 drops of patient plasma into each labeled crossmatch tube.
5	Add 1 drop of each donor cell suspension to the corresponding crossmatch tube.
6	Add 2 drops of LISS reagent to each tube and mix gently.
7	Incubate at 37±2°C for 15 minutes. Incubation time may be extended for a maximum of 30 minutes.
8	Examine tubes macroscopically for hemolysis. Record if hemolysis present.
9	Serofuge for the posted time in a calibrated serofuge (generally 15 seconds).

Step	Action
10	Read macroscopically for agglutination using an agglutination viewer.
11	Record results immediately in the LIS or on a downtime form.
12	Wash tubes a minimum of 4 times using saline. Use of an automated cell washer is preferred.
13	Add 2 drops of anti-IgG to each tube. Note: Anti-IgG is preferred when LISS enhancement is used. However, polyspecific AHG may be substituted.
14	Gently mix the tubes and **immediately** serofuge for the time posted on the calibrated serufuge (generally 15 seconds).
15	Read macroscopically for agglutination using an agglutination viewer. Record results immediately in the LIS or on a computer downtime form. Refer to procedure, "Key to Symbol/Abbreviations for Reaction Grading and Interpretations."
16	Confirm the validity of negative reactions with check cells. A. Add one drop of Coombs Control Cells (check cells) to each negative tube. B. Mix thoroughly. C. Serofuge for the time listed on the serofuge (generally 15 seconds). D. Read macroscopically for agglutination with the use of an agglutination viewer. E. Record results immediately in the LIS or on a computer downtime form. F. Agglutination **must** be present at strength of 2+ or greater or the test results are invalid and the entire test must be repeated.
17	Refer to procedure, "Key to Symbol/Abbreviations for Reaction Grading and Interpretations." A. No agglutination at the AHG phase represents a compatible crossmatch (as long as the check cells are ≥2+ positive and the donor unit is negative for antigens if applicable, refer to Appendix B). B. Agglutination of any type at the AHG phase represents an incompatible crossmatch. DO NOT tag for issue until resolved.

8.5 Tagging the Units for Issue

Step	Action
1	The pink "Blood Bank Product Tag and Administration Record" will print following computer entry of the results. If the computer is down, the form must be completed manually.
2	Remove the form from the printer.
3	Match each form with the appropriate unit. Place the form in the unit holder with the unit. Place the unit on the appropriate shelf of the crossmatched blood refrigerator.
4	If the crossmatch was performed before an ABO confirmation specimen has been received or tested, place a note on the unit indicating it cannot be issued until the ABO retype is complete.

8.6 Resolving Unexpected Red Cell Crossmatch Incompatibility

This procedure is used when the crossmatch is incompatible without obvious cause.

Step	Action
1	Verify that red cells of the appropriate ABO group have been selected for crossmatch. A. If the units are an incorrect ABO group, re-crossmatch with red cells of the correct ABO group. B. If the units are the correct ABO group, proceed to step 2.
2	Recheck the patient's blood bank historical data per procedure, "Blood Bank History Review." Ensure that you have accurately reviewed the patient's history and that no antibodies or testing problems have been missed.
3	Perform a careful visual inspection of the donor unit. Ensure there are no clots, clumps, or discolorations. Discard a unit that does not pass the visual inspection.
4	Hints for resolving incompatibility: A. Negative Antibody Screen, Incompatible Immediate Spin Crossmatch a. Rouleaux—examine the tube(s) under the microscope and perform a saline replacement per procedure, "Saline Replacement Technique." b. Polyagglutination—mix 1 drop of donor red cells and 2 drops of saline. Serofuge and read. If agglutination is present, the problem is with the unit. Notify the blood supplier and complete an incident report. Do not transfuse the unit.

Step	Action
	c. Cold antibodies— i. Allow donor cells and patient plasma to warm to room temperature and repeat testing through AHG phase using LISS tube methodology. ii. Perform an immediate spin screen to determine if a cold antibody is present (perform an immediate spin panel if indicated). iii. The crossmatch can be interpreted as compatible if all of the following conditions are met. 1. A cold antibody is identified. 2. The AHG crossmatch in LISS tube is negative. 3. The ABO and Rh of the patient and each unit is verified for compatibility. d. Passively acquired antibodies—verify the patient's transfusion history. The patient may have gotten passively acquired anti-A or anti-B from a platelet or plasma product transfusion. B. Positive AHG Crossmatch a. Verify that the unit is negative for the appropriate antigens, if applicable. b. Perform a DAT on the donor unit. If positive, notify the blood supplier and complete an incident form. Do not transfuse the unit. c. A possible antibody to a low frequency antigen may be present in the recipient plasma. Crossmatch a different unit to the patient. Repeat the antibody screen if a second unit is incompatible.

9. CALCULATIONS

N/A

10. REPORTING RESULTS AND REPEAT CRITERIA

10.1 Interpretation of Data

Interpretation is included in section 8.

11. EXPECTED VALUES

N/A

12. CLINICAL SIGNIFICANCE

A compatibility test with recipient's plasma and donor red cells aids in the selection of blood components that, when transfused, will have acceptable survival and will not cause clinically significant destruction of the recipient's own red cells.

13. PROCEDURE NOTES

A. **FDA Status:** FDA Approved/cleared

B. **Validated Test Modifications:** None

C. Crossmatches are not abbreviated in the case of a massive transfusion (replacement amount approximating or exceeding the recipient's total blood volume within a 24-hour interval.) Any exception would be at the pathologist's discretion and must be documented on the Pathologist Consultation Form.

D. If group AB red cells are not available for a group AB patient, group A packed cells are preferred but group B may be given if the group A inventory is low.

E. In emergency situations where Rh-negative red blood cells are not readily available, Rh-positive blood may be transfused to an Rh-negative patient (male or female greater than 50 years old) with the pathologist's or supervisor's approval. In the LIS utilize the canned message code **CTAP** as an issue comment to document this approval. An access code and password are required to override the QA failure in the LIS. The supervisor can enter this information if onsite. During off hours, contact the supervisor or LIS on-call staff for an access code and password.

Note: Treatment with Rh immune globulin is not routinely performed. If the patient subsequently develops anti-D, future transfusions will require Rh negative blood. Consult the pathologist if a physician requests that RhIG be administered.

F. If the patient has been transfused ABO incompatible platelets or cryoprecipitate and has a positive DAT with elution of anti-A or Anti-B, transfuse type O Rh compatible RBC's until the DAT is no longer positive.

G. The test ABO confirmation (test code RTYP) must be performed on patients with no Blood Bank history prior to the issue of ABO-compatible red cells. In emergency situations when this test cannot be performed using a sample collected at a separate time, O packed cells will be crossmatched. The Rh type selected will be chosen to match the initial Rh type from the T&S specimen. Consult the pathologist if the confirmatory sample is not received within a reasonable amount of time based on the situation. The Pathologist will determine if transfusions with O red cells will continue based on the red cell inventory in the Blood Bank. Neonates less than 4 months of age will not be required to have an ABO confirmation performed unless they are to be transfused with non-O red cells. Refer to procedure, "Confirmation of Patient's Blood Type (ABO Recheck)."

14. LIMITATIONS OF METHOD

14.1 Analytical Measurement Range (AMR)

N/A

14.2 Precision

- The IgG crossmatch using Capture-R Select on the Echo is intended only for the detection of incompatibilities due to IgG antibodies. The RBC IgG crossmatch is **NOT** intended for the detection of incompatibilities due to IgM antibodies, such as ABO incompatibilities. If the detection of incompatibilities due to IgM antibody are necessary, then the immediate spin crossmatch must be used.
- It is possible for IgM antibodies to react with the test system. This does not occur because the system detects IgM antibodies, but because the antibody is directed toward an antigen on the Indicator cells.
- Plasma from samples obtained from tubes containing neutral gel separators may produce falsely positive results in antibody screening tests. Tubes with gel separators are not designed for blood bank use.
- Some samples may contain heterophilic antibodies. Samples with high titer heterophilic antibody may demonstrate a positive reaction which is unrelated to red blood cell antibodies.
- Donor red blood cells with a positive direct antiglobulin test (DAT) will produce a false positive result in crossmatch testing.
- Contamination of Capture-R Ready Indicator Red Cells with IgG-containing plasma proteins will neutralize the anti-IgG component of the Capture-R Ready Indicator Red Cells, leading to falsely negative test results. Failure of the Capture-R Positive Control is an indication of neutralization in manual or semi-automated testing.
- Examples of pure IgG4 subclass antibodies may not be detected by the Capture-R Ready Indicator Red Cells reagent.
- No single testing method is capable of detecting all antibodies.
- Negative reactions will be obtained if the test plasma contains antibodies present in concentrations too low to be detected by the test methods employed.
- Antibodies below threshold level may not be detected by this test.
- Significant variations in red blood cell suspensions may result in false-positive or false-negative reactions.
- The ionic strength of the mixture is dependent upon the amount of plasma used.
- Proper centrifuge calibration is particularly important to performance.
- Falsely positive or falsely negative test results can occur from bacterial contamination of test materials, inadequate washing of red cells, improper storage of test materials, and omission of antiglobulin reagent (AHG tube testing).

14.3 Interfering Substances

Gross hemolysis, icterus, and/or lipemia can cause false results.

14.4 Clinical Sensitivity/Specificity/Predictive Values

N/A

15. SAFETY

You, the employee, have direct responsibility to avoid injury and illness at work. Nearly all harmful exposures to infectious substances and chemicals, and other injuries, can be avoided with effective training and consistent safe work practices.

Become familiar with the Environmental, Health and Safety (EHS) Manual to learn the requirements on working safely and protecting the environment from harm. Although lab work typically focuses on the hazards of working with specimens and chemicals, we must also control other important hazards.

- Slips, trips, and falls cause many serious injuries. Please ensure that spills are cleaned quickly (to avoid slippery floors) and that you can see and avoid obstacles in your path.
- Ergonomic injuries result from performing tasks with too much repetition, force, or awkward position. Ergonomic injuries include strains and back injuries. Learn about ergonomic hazards and how to prevent this type of injury.
- Scratches, lacerations, and needlesticks can result in serious health consequences. Attempt to find ways to eliminate your risk when working with sharp materials.
- Warnings of other specific hazards are noted in this procedure. Please comply with the requirements to reduce your risk of injury."

Report all accidents and injuries to your supervisor or the Environmental, Health and Safety Coordinator.

16. RELATED DOCUMENTS

SOP: Blood Bank Verbal Product Orders
SOP: Confirmation of Patient's Blood Type (ABO Recheck)
SOP: Patient History Check
SOP: Preparation of a 2-4% Cell Suspension for Patient Testing
SOP: Sample Specifications for Blood Bank Testing
SOP: Blood Bank Reaction Grading
SOP: Echo Quality Control
SOP: Daily Reagent Quality Control
SOP: Galileo Echo Testing Patient Samples
Form: Pathologist Consultation Form

17. REFERENCES

A. Roback, J.D., Combs, M.R., Grossman, B.J., Hillyer, C.D. 2008. Technical Manual of the AABB, 16th ed. AABB Publishing, Bethesda, Maryland.
B. Standards for Blood Banks and Transfusion Services, 26th ed. AABB Publishing, Bethesda, Maryland.
C. Berte, L.M. 2007. Transfusion service manual of standard operating procedures, training guides, and competency assessment tools, 2nd ed. AABB Publishing, Bethesda, Maryland.

D. Petrides, M, Stack, G, Cooling, L, Maes, L. 2007. Practical Guide to Transfusion Medicine, 2nd ed. AABB Publishing, Bethesda, Maryland.
E. Package Insert for Anti-Human Globulin Anti-IgG (Rabbit) MTS Anti-IgG Card, Pompano Beach, FL: Micro Typing Systems, Inc.
F. Package Insert for ImmuAdd Low Ionic Strength Medium for Antibody Detection Tests, ImmucorGamma, Inc., Norcross, GA, Insert Code 321-11, Revision Date 9/2007.
G. Package Insert for Anti-IgG (Murine Monoclonal), ImmucorGamma, Inc., Norcross, GA, Insert Code 3001-1, Revision Date 10/2007.
H. Package Insert for CheckCell Antiglobulin Control IgG-Coated Pooled Red Blood Cells, ImmucorGamma, Inc., Norcross, GA, Insert Code 307-14, Revision Date 10/2007.
I. Package Insert for Capture-R Select, ImmucorGamma, Inc., Norcross, GA, Insert Code 343-5, Revision Date 01/2007.
J. Package Insert for Capture-R Positive (Weak) and Negative Control Serum, ImmucorGamma, Inc., Norcross, GA, Insert Code 352-5, Revision Date 12/2005.

18. REVISION HISTORY

Version	Date	Section	Reason	Reviser	Approval
			Supersedes SGAH.BB19.001, WAH.BB16.001		
000	9.11.12	8, 19.E	Removed instructions for performing manual capture crossmatches.	SCodina	NCacciabeve
001	6.20.13	8.1 8.6 19	Added instructions to verify patient name, MRN, and BB# matches between sample and computer. Edited instructions for handling incompatible IS XMs due to strong cold antibodies. Added Appendix G.	SCodina	NCacciabeve

19. ADDENDA

Addendum	Title
A	Selection of Red Blood Cells and Whole Blood for Crossmatch
B	Flow chart for second sample for ABO confirmation
C	Allocation of Units in the LIS
D	LIS Entry of Immediate Spin Crossmatch
E	LIS Order and Entry of a Crossmatch Performed On Echo
F	LIS Order and Entry of a manual tube AHG Crossmatch
G	Resulting an Incompatible Crossmatch Due to Warm Autoantibodies

Appendix A

Selection of PACKED RED BLOOD CELLS For Crossmatch						
Patient Group & Rh	**(choices in order of preference)**					
O+	O+	O=				
O=	O=					
A+	A+	A=	O+	O=		
A=	A=	O=				
B+	B+	B=	O+	O=		
B=	B=	O=				
AB+ *	A+	A=	B+	B=	O+	O=
AB= *	A=	B=	O=			

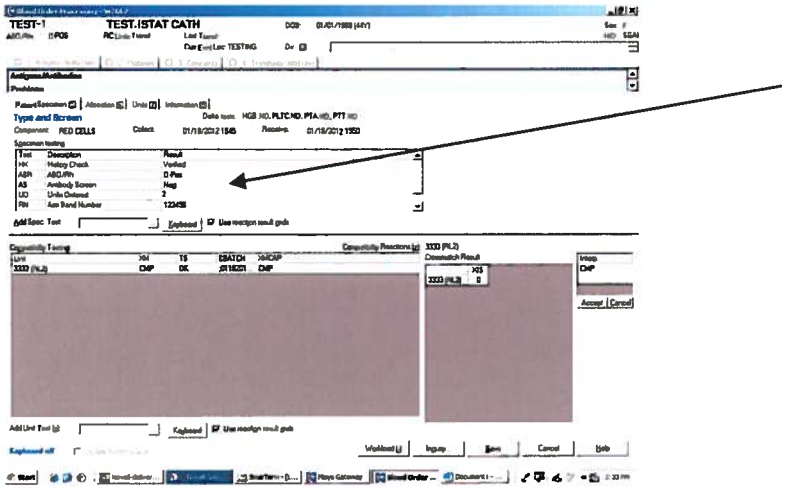
- AB, Rh-compatible blood is selected first if inventory is available.

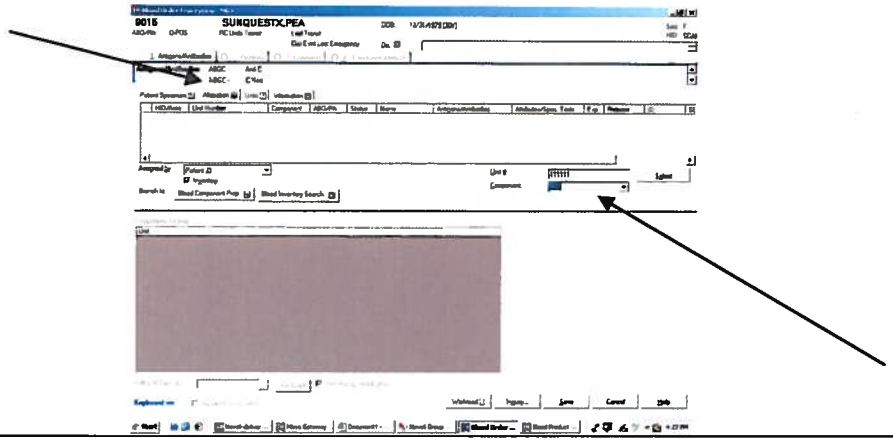
Selection of WHOLE BLOOD For Crossmatch						
Patient Group & Rh	**(choices in order of preference)**					
O+	O+	O=				
O=	O=					
A+	A+	A=				
A=	A=					
B+	B+	B=				
B=	B=					
AB+	AB+	AB=				
AB=	AB=					

Appendix B
Clinical Significance of Antibodies and the Provision of Red Cells

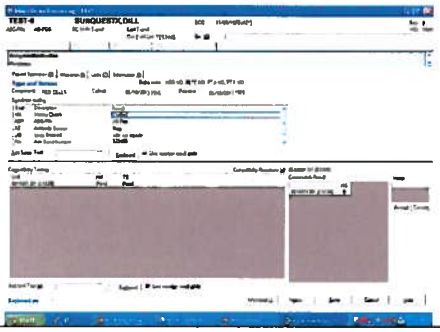
	Antibody Specificities	Is Antigen Negative Blood Required?	Is An AHG Crossmatch Required?
Clinically Significant Antibodies	D, C, E, c, e K, k S, s Jk^a, Jk^b Fy^a, Fy^b	Yes, for both current and historical antibodies	Yes, for both current and historical antibodies
Clinically Insignificant Antibodies	N P_1 Le^a, Le^b Lu^a Clinically Insignificant Antibodies to Low-Frequency Antigens	No	Yes, if the antibody is currently demonstrating No, if the antibody is no longer showing
Anti-M	Anti-M only	No	Yes, for both current and historical antibodies
	Anti-M plus a warm autoantibody with broad, undetermined specificity	Yes	
Clinically Significant Antibodies to Low Frequency Antigens	Kp^a Wr^a Js^a Di^a Co^b C_w	Yes—When the antibody demonstrates at <1+ in strength No—When the antibody demonstrates at strengths of ≥1+ (Do NOT transfuse incompatible units)	Yes, for both current and historical antibodies
Anti-A_1 Antibody	A_1	Yes—If group A or AB units are used No—If non-group A units are used • O for A patients • B or O for AB patients	Yes, if the antibody is currently demonstrating No, if the antibody is no longer showing
Passive Antibodies	Passive Anti-D (Administration of anti-D, RhIG, or WinRho within the previous 3 months must be documented)	Yes NOTE: The pathologist may decide to give Rh-positive blood products to patients undergoing WinRho treatment for ITP.	Yes—When antibody showing No—When antibody screen is negative
Warm Autoantibodies	All Major Blood Group Antibodies Excluded	No	Yes, if antibody is currently demonstrating No, if antibody is no longer showing
Unidentified/Inconclusive Antibodies	All Major Blood Group Antibodies Excluded	Not Applicable	Yes—When antibody showing No—When antibody screen is negative

Appendix C
Allocation of Units in the LIS

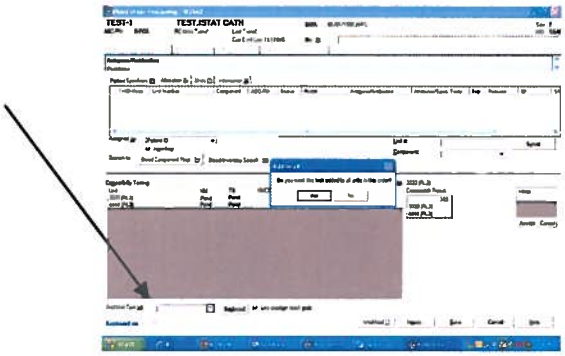
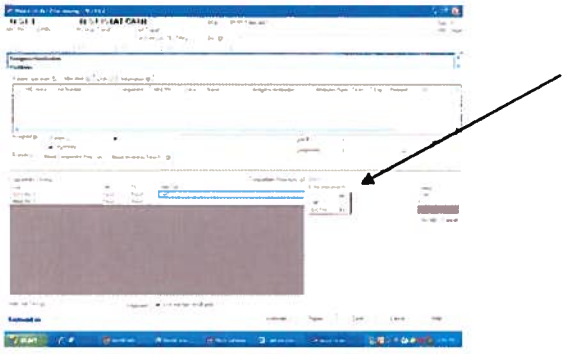
Step	Action
1	Access Sunquest function "Blood Order Processing."
2	In the "Lookup by" field, select "Patient ID" from the dropdown menu.
3	In the "Value" field, type the patient's medical record number and click on the "search" button.
4	All patients for whom that medical record number is assigned will appear. Select the correct patient by double-clicking on the correct row.
5	The patient's historical blood bank data will appear. Review the data to ensure the unit(s) selected meet all patient criteria.
6	Click on the "Order Selection" tab.
7	Select the T&S specimen on which the red cells will be crossmatched by highlighting the specimen and clicking on the "Select" button.
8	Review the patient's T&S data to ensure: A. All testing has been performed. B. All testing is resulted. C. Positive antibody screen tests have been resolved.
9	Update the number of units ordered. A. Click on the "Patient Specimen" tab. B. Update the units in the "Units Ordered" field. a. The number of units should match the total number of units crossmatched to this specimen. b. Add the number of units currently being crossmatched to the number currently in the field if an entry already exists. 

Step	Action
10	Click on the "Allocation" tab. 
11	Barcode the unit number in the "Unit #" field. Only type the unit number into this field when the barcode is damaged or unreadable. A. If the unit number is barcoded, the computer will prompt you to enter the supplier. B. Barcode the supplier from the unit.
12	The computer will prompt you to enter the component type if more than one component with the same unit number has been in inventory. Barcode the product type into the LIS or select the correct product type from the drop-down menu.
13	Click on the "Select" button.
14	Continue steps 10-12 for each additonal unit to be crossmatched.
15	Click the "Save" button.

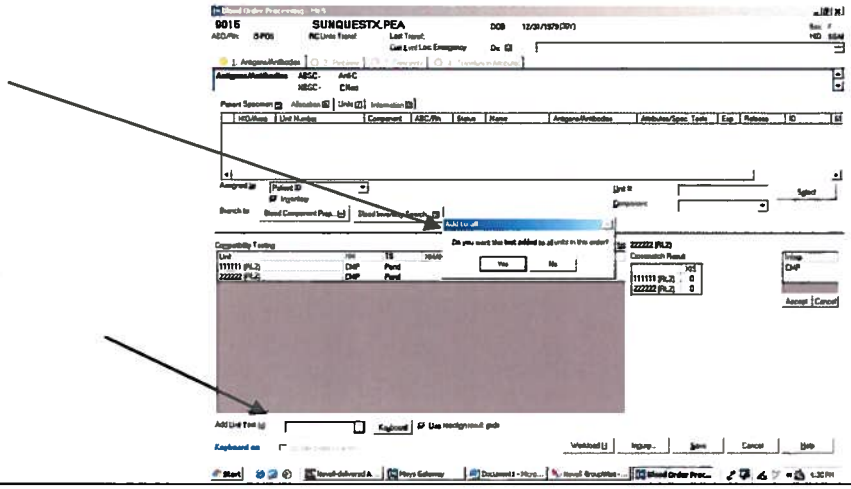
Appendix D
LIS Entry of Immediate Spin Crossmatch

Step	Action
1	Access the T&S specimen using Sunquest function "Blood Order Processing." Click on the "Allocation" tab.
2	Enter the results of the immediate spin reactions in the "Crossmatch Results" grid.
3	If all crossmatch testing is complete for the unit, proceed to step 4. If additional testing (including AHG crossmatch testing) needs to be performed, A. Click the "Accept" button. B. Click the "Save" button. 
Do not proceed to step 4 until crossmatch testing for the unit has been completed. This includes AHG crossmatches performed on the Echo or in tube.	
4	Interpret the crossmatch in the "interp" area. **This field interprets the entire crossmatch, including the AHG crossmatch.** A. Type "[" for compatible B. Type "{" for incompatible In situations where a patient has a strong cold antibody that interferes with immediate spin typing: A. Carry the reactions through AHG phase. B. If the AHG phase is negative (compatible), verify the units are compatible with the patients ABO/Rh and any current or historical clinically-significant antibodies. C. Result the crossmatch as compatible if you are sure immediate spin results are due to interference of the cold antibody.
3	Complete the "TS" field. **This field interprets the entire crossmatch, including the AHG crossmatch.** A. Type "]" for "OK to transfuse" B. Type "}" for not "OK to transfuse"
4	Click on the "Save" button.

Appendix E
LIS Order and Entry of a Crossmatch Performed On Echo

Step	Action
1	Units must be allocated to the patient per Appendix C prior to adding on the Echo/Capture crossmatch.
2	Order the crossmatch. A. Access the recipient's T&S specimen in Sunquest. B. In the "Add Unit Test" field, order the crossmatch to be performed. Order "XMECHO" if the crossmatch was performed on the Echo. C. The LIS will prompt, "Do you want this test added to all units in this order?" Click on the "YES" button. D. The test(s) will add to each unit allocated. 
3	Type the reaction result of the crossmatch in the "XIGG" grid. Then click the "Accept" and "Save" buttons. A. XM is the crossmatch reaction result B. IDCTRL is the DAT Positive Control Result (Echo XM Only) 
4	Proceed to step 4 of appendix A after all testing has been performed.

Appendix F
LIS Order and Entry of a Manual Tube AHG Crossmatch

Step	Action
1	To add a tube AHG crossmatch: A. Access the T&S specimen in "Blood Order Processing." B. In the "Add Unit Test" field, type "t" (shift + T) or ";XMAHG" and press the tab key. C. The computer will prompt, "Do you want this test added to all units in this order?" a. Click on the "yes" key to add the AHG crossmatch to all units. b. Click on the "no" key if you want to add the AHG crossmatch only to selected units. 
2	Enter the results of the crossmatch in the "Coombs Crossmatch" grid. Click the "Accept" and "Save" buttons. A. XLISS is for the 37°C LISS reading. B. XIGG is for the reading after addition of anti-IgG. C. XCC is for the results of the check cells. Keypad Map for Result Reactions 7 **H** | 8 **RL** | 9 **NT** 4 **4+** | 5 **M+** | 6 **MF** 1 **1+** | 2 **2+** | 3 **3+** **0** | . **NE** H = Hemolysis RL = Rouleaux NT = Not tested M+ = Microscopic MF = Mixed field NE = Neonatal backtype
3	Proceed to step 4 of appendix A after all testing has been performed.

Appendix G
Resulting an Incompatible Crossmatch Due to Warm Autoantibodies

Step	Action
1	The blood bank may not be able to find crossmatch compatible blood products when the recipient has a warm autoantibody. In this situation, least incompatible blood products are issued with an emergency release form provided the following conditions are met: A. Auto- or allogeneic adsorptions have been performed by a reference laboratory. Subsequent adsorptions do not need to be performed during the same admission if the patient has not been transfused or pregnant within the previous 90 days. B. The units are compatible with the recipient's clinically-significant antibodies (current or historic).
2	Perform crossmatch testing as outlined in the appendices above. Enter results for each type of crossmatch performed (Echo, AHG, Prewarm, etc).
3	Interpret the crossmatch by typing a plus sign "+" in the "interp" field. The "+" sign will expand to "Least Incompatible."
4	Complete the "TS" field. **This field interprets the entire crossmatch, including the AHG crossmatch.** C. Type "]" for "OK to transfuse" D. Type "}" for not "OK to transfuse"
5	Click on the "Save" button.
6	Interpretation of a "least incompatible" crossmatch will generate a QA failure. Ensure the QA failure(s) generated are all due to an interpretation of "least incompatible" then override using mnemonic "LIWAA." This expands to, "Least Incompatible XM Due To WAA."