



**ARMY MEDICINE**  
Serving To Heal...Honored To Serve

# Advances in the Use of Whole Blood in Combat Trauma Resuscitation

## Defense Health Board

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Director, Army Blood Program

Deputy Director, Army Blood Program

2 June 2016

## Agenda

**Whole Blood Pre-hospital**

**75<sup>th</sup> Ranger Regiment ROLO Program**

**ASBP Manufactured Whole Blood**

**Future Work**



# Armed Services Blood Program

Provide quality blood products and support to military healthcare operations worldwide.



# Whole Blood on the Battlefield

**Fresh whole blood use by forward surgical teams in Afghanistan is associated with improved survival compared to component therapy without platelets**

TRANSFUSION 2013;53:107S-113

Shawn C. Nessen, Brian J. Eastridge, Daniel Cronk, Robert M. Crain, Kyle Remick, Jason Seery, Avani Shah, and Phil...

*The Journal of TRAUMA® Injury, Infection, and Critical Care*

*J Trauma.* 2009;66:S69-S76.

**Warm Fresh Whole Blood Is Independently Associated With Improved Survival for Patients With Combat-Related Traumatic Injuries**

Philip C. Spinella, MD, Jeremy G. Perkins, MD, Kurt W. Grathwohl, MD, Alec C. Beekley, MD, and John B. Holcomb, MD

**Comparison of platelet transfusion as fresh whole blood versus apheresis platelets for massively transfused combat trauma patients**

TRAUMA SHOCK, Vol. 41, No. Supplement 1, pp. 62-69, 2014

Jeremy G. Perkins, Andrew P. Cap...  
Kurt W. Grathwohl, Francisco J. Re...  
Combat Su...

**WHOLE BLOOD: THE FUTURE OF TRAUMATIC HEMORRHAGIC SHOCK RESUSCITATION**

Alan D. Murdock,<sup>\*†</sup> Olle Berséus,<sup>‡</sup> Tor Hervig,<sup>§||</sup> Geir Strandenes,<sup>§¶</sup> and Turid Helen Lunde<sup>§</sup>

# CPG Fresh Whole Blood

## Joint Theater Trauma System Clinical Practice Guideline

### FRESH WHOLE BLOOD (FWB) TRANSFUSION

Original Release/Approval	Oct 2006	Note: This CPG requires an annual review.	
Reviewed:	Oct 2012	Approved:	24 Oct 2012
Supersedes:	Fresh Whole Blood (FWB) Transfusion, updated 17 Jul 2012		
<input type="checkbox"/> Minor Changes (or)	<input checked="" type="checkbox"/> <i>Changes are substantial and require a thorough reading of this CPG (or)</i>		
<input type="checkbox"/> Significant Changes			

- 1. Goal.** Provide the rationale and guidelines for FWB transfusion, including but not limited to indications, collection, testing, transfusion, and documentation.
- WB use is based on ABO type specific match, donor & recipient
  - Product destroyed after 24 hours
  - Collect FWB in emergency situations, no pre-collection/storage
  - <http://www.usaisr.amedd.army.mil/cpgs.html>



# Blood Utilization



## OEF/OFS and OIF/OND/OIR Patient Transfusions by Blood Product Type

As of 29 February 2016

	Total # of Products Transfused	Total # of Patients Receiving this Product Type	Avg # of Products per Transfused Patient	Low	Mode	Median	High
RBC	176,911	36,163	4.9	1	2	3	137
FFP	108,353	18,750	5.8	1	2	4	124
CRYO	31,315	3,224	9.7	1	10	10	120
A-PLT	11,430	5,166	2.2	1	1	2	42
WB	10,242	1,733	5.9	1	2	4	61
DRBC*	946	456	2.1	1	1	2	16
<b>Total # of Products Transfused to All Patients</b>		<b>Total # of Patients Receiving at Least One Unit of Any Product Type</b>	<b>Avg # of Products per Transfused Patient</b>	<b>Low</b>	<b>Mode</b>	<b>Median</b>	<b>High</b>
<b>339,197</b>		<b>39,891</b>	<b>8.5</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>401</b>

\* Began using DRBCs in 2008 based on JTTS CPG.

# Blood on the Battlefield

- Whole Blood Transfusion 2001-2016 focused at R2/R3
- 90% of combat deaths occur before reaching R2
- 25% of combat deaths preventable
- 90% of preventable deaths – due to Hemorrhage

Eastridge et al. *J Trauma* 2013.

Kotwal et al. *Arch Surg* 2011.

## TCCC Guidelines Change 14-01

28 June 2014



# TCCC Fluid Resuscitation

- TCCC Guidelines for Medical Personnel – 3 June 2015
  - 7. Fluid resuscitation
    - a. The resuscitation fluids of choice for casualties in hemorrhagic shock, listed from most to least preferred, are: whole blood\*; plasma, RBCs and platelets in 1:1:1 ratio\*; plasma and RBCs in 1:1 ratio; plasma or RBCs alone; Hextend; and crystalloid (Lactated Ringers or Plasma-Lyte A)
- Some progress on use of plasma far forward, but ASBP unable to provide platelets in pre-hospital setting
- TCCC Guidance has focused attention on WB use pre-R2/R3





# Low Titer Group O Whole Blood

**SHOCK**, Vol. 41, Supplement 1, pp. 70–75, 2014

## LOW TITER GROUP O WHOLE BLOOD IN EMERGENCY SITUATIONS

Geir Strandenes,<sup>\*†</sup> Olle Berséus,<sup>‡</sup> Andrew P. Cap,<sup>§</sup> Tor Hervig,<sup>\*||</sup> Michael Reade,<sup>||</sup>  
Nicolas Prat,<sup>§\*\*</sup> Anne Sailliol,<sup>††</sup> Richard Gonzales,<sup>‡‡</sup> Clayton D. Simon,<sup>§§</sup>  
Paul Ness,<sup>||||</sup> Heidi A. Doughty,<sup>|||</sup> Philip C. Spinella,<sup>§\*\*\*</sup> and Einar K. Kristoffersen<sup>\*||</sup>

- Proposed low-titer Group O WB for emergency situations when type-specific WB unavailable
- Donor pool screened prior to deployment
- WB maintains normal TEG/hemostatic parameters out to almost 21 days but platelet function begins to drop after 14 days

Pidcock et al. *Transfusion* 53:137S-149S, 2013



# ABO Incompatibilities

- Major ABO Incompatibility
  - Transfusion of donor RBCs to a patient with incompatible ABO antibodies
  - Acute Hemolytic Transfusion Reactions – severe, can be fatal
  - Typically caused by larger, complement activating IgM class ABO antibodies
  - May be caused by smaller IgG class ABO antibodies if present in high concentration
  - No risk if transfusing type specific WB or type O WB
- Minor ABO Incompatibility
  - Transfusion of donor ABO antibodies which are incompatible with patient RBCs
  - Clinically apparent reactions are rare and typically mild
  - No data on risk from WB, but apheresis platelet studies available
  - 2 reactions observed in 3816 transfusions with non-group O patients receiving group O platelets (0.05%)\*
  - Using titrated donors, risk estimated as 1:120,000 for out of group transfusions\*\*
  - 25 case reports of hemolytic transfusion reactions, 1975-2009, with transfusion of group O platelets to non-group O recipients\*\*\*
    - 2 fatalities involving cancer patients

\* Fauzie D, Transfusion 2004; 44(Suppl):36A

\*\* Strandenes G, Berseus O, Cap AP, Shock 2014; 41(1): S70-5

\*\*\* Bersus O, Transfusion 2013; 53:114S-123S



# ABO Antibody Titer Testing

- Titer Testing
  - May be performed to limit risk of minor ABO incompatibility
  - Titer result traditionally reported as the highest donor plasma dilution which results in visible agglutination – ie...Anti-A 1:128 or Anti-B 1:64
  - Uses Reagent A & B red cells
  - Saline used as diluent, tubes centrifuged and observed for visible agglutination
  - Anti-Human Globulin (AHG) may be added to test for IgG
  - Wide variation between countries on need to test for both IgM and IgG and acceptable titer values
  - Variation in testing methodology – tube vs. gel card testing



# 75th Ranger Regiment

*Whole Blood and Titters*

- Spring 2015, Ranger Regiment requested support for ROLO (Ranger O Low Titer) program
- **Goal:** Identify low-titer Group O WB donors prior to Deployment of personnel from CONUS
- Program initiated at Ft. Benning, GA with 3rd Battalion, 12 May 2015
- Screening coordinated with Sullivan Memorial Blood Center, Ft. Benning, GA



# 75th Ranger Regiment

## Whole Blood and Titters

BLOOD DONATION RECORD										DONATION IDENTIFICATION NUMBER	
<b>SECTION I –</b>											
1. DONATION FACILITY											
<b>SECTION II – (to be completed by donor)</b>											
2. DONOR PROC		3. TODAY'S DATE		4. ID TYPE		5. ID NUMBER		6. CHAGAS			
7. NAME (Last, First, Middle Initial)		8. GRADE/RATE		9. DATE OF BIRTH		10. AGE	11. SEX M F	12. ETHNICITY		13. ABO/Rh	
14. CURRENT MAILING ADDRESS (Street, City, State, Zip Code)				15. COUNTRY		16. DUTY PHONE (Include Area Code)		17. BEST CONTACT PHONE (Include Area Code)			
18. ORGANIZATION			19. STATION			20. Total Donations		21. DONOR ID			
<b>SECTION III – (to be completed by donor center personnel)</b>		22. DEFERRAL LIST CHECKED BY	23. DONOR ID VERIFIED BY	24. WEIGHT	25. TEMP	26. PULSE	27. BP	28. HGB/HCT	29. ARM CHECK	30. GENERAL APPEARANCE	
31. VITAL SIGNS MONITOR		32. HEMOGLOBINOMETER				33. SCALE					
34. DOES DONOR QUALIFY? YES NO TECH:		36. BAG LOT NO.			38. SEGMENT NO.			37. REVIEWER			
<b>DONOR MEDICAL HISTORY (Indicate "Y" for Yes or "N" for No)</b>											
1	Are you feeling healthy and well today?	Y	N	28	In the past three years, have you been outside the United States or Canada?	Y	N				
2	Are you currently taking an antibiotic?	Y	N	<b>FROM 1980 THROUGH 1996</b>							
3	Are you currently taking any other medication for an infection?	Y	N	29	Did you spend time that adds up to three (3) months or more in the United Kingdom? (Review list of countries in the U.K.)	Y	N				
4	Please read the Medication Deferral List. Are you now taking or have you ever taken any medications on the Medication Deferral List?	Y	N	30	Were you a member of the U.S. military, a civilian military employee, or a dependent of a member of the U.S. military?	Y	N				
5	Have you read the educational materials?	Y	N	<b>FROM 1980 TO THE PRESENT, DID YOU</b>							
6	In the past 48 hours, have you taken aspirin or anything that has aspirin in it?	Y	N	31	Spend time that adds up to five (5) years or more in Europe? (Review list of countries in Europe.)	Y	N				
7	Female Donors: In the past 6 weeks have you been pregnant or are you pregnant now? I am male <input type="checkbox"/>	Y	N	32	Receive a blood transfusion in the United Kingdom or France? (Review list of countries in the U.K.)	Y	N				
8	In the past 8 weeks have you donated blood, platelets or plasma?	Y	N	<b>FROM 1977 TO THE PRESENT, HAVE YOU</b>							
9	In the past 8 weeks have you had any vaccinations or other shots?	Y	N	33	Received money, drugs, or other payment for sex?	Y	N				
10	In the past 8 weeks have you had contact with someone who had a smallpox vaccination?	Y	N	34	Male donors: Had sexual contact with another male, even once? I am female <input type="checkbox"/>	Y	N				
11	In the past 16 weeks have you donated a double unit of red cells using	Y	N								

### ASBP-572

- Same screening form used for routine blood donors
- No vitals conducted at time of pre-screen
- Donor signs consent



# 75th Ranger Regiment

## *Whole Blood and Titters*

- Collection of Group O Donors must be coordinated with the ABP, designated BDC and Department of Pathology.
- Volunteer (potential) donors complete an ASBP-572 and interview process with BDC staff.
- Rangers are briefed that program is voluntary
- Tubes for Transfusion Transmitted Disease (TTD) testing collected/labeled:
  - HBsAg
  - Anti-HBc
  - HBV Nucleic Acid Test (NAT)
  - Anti-HCV + HCV NAT
  - Anti-HIV-1/2 + HIV-1 NAT
  - Anti-HTLV I/II
  - Syphilis (RPR)
  - ABO/Rh, Antibody Screen
  - West Nile Virus NAT
  - T. cruzi



# TTD and Titer Results

- Tube for titer testing collected/labeled:
  - Must be coordinated with local MTF, Department of Pathology.
  - Titers  $\geq 1:256$  are considered “High Titer”.
  - Titers  $< 1:256$  are considered “Low Titer”.
- Titer testing is ordered and resulted in CHCS.
- Titer results + ABO/Rh + TTD & Antibody Screen Results + ASBP-572's = Donors and results placed into TMDS for visibility by Regimental Medical Officers and Readiness Coordinators
- Deferrals placed into ASBP Blood Establishment Computer System
- All positive testing results are reported to Regimental Surgeon, PA and Medical Readiness Coordinator for proper counseling and follow-up testing if required.
- **Planning and coordination required!**



# ROLO Expansion

**TMDSPortal**

**TMDS** | **Blood**

**Blood**

UNCLASSIFIED//FOR OFFICIAL USE ONLY

viewing 10th SF Group (BNS003) FACILITY

[Manage Donation](#) | [Manage Donor](#) | [Manage Inventory](#) | [Transfusion](#) | [Reports](#) | [Blood Admin](#) | [Change Blood Facility](#)

Your Location: [Blood](#) > [Manage Donation](#) > Update Donation

### Update donation - update tests

The following donor:

**Nationality:** United States of America  
**Branch:** U.S. Army  
**Gender:** M  
**ABO/Rh:** O POS  
**Military Unit:** 3-75 RR RASP1

...donated the following blood products

**DIN:** W013516750023    **Donation Date:** 25 Jan 2016    **Donation Location:** 75th Ranger Regiment (BNS001)

**Donated Product(s)**

PRODUCT DESCRIPTION	ABO/RH	EXP. DATE	DISPOSITION	LOCATION
PRESCREE - PRESCREE	O POS	25 Jan 2017	AVAILABLE	75th Ranger Regiment (BNS001)

**Enter rapid testing results here:**

**ABO/Rh:** -- Select ABO/Rh --    **HIV:** ??    **HCV:** ??    **HBsAg:** ??  
**RPR:** ??    **Other:** ??    **Other Test Types:**

**Date Tested:**     **Samples sent to:**  on:

**Enter TTD testing results here:**

**ABO/Rh:** O Positive    **ABS:** Negative    **STS:** Negative    **HBsAg:** Negative    **HBcAb:** Negative  
**HCV:** Negative    **HIV 1/2:** Negative    **HTLV 1/2:** Negative    **WNV:** Negative    **NAT:** Negative    **Chagas:** Negative

**Comments:** HIGH TITER, PERFORMED BY LABCORP

**Date Shipped CONUS:**     **Date Tested:**     **Donor Notified?:** No

**DD-572 Complete?:** Yes

[Browse...](#)



# ABP Policy and SOP

## ABSOP for Special Operations Donor Screening

### Overview

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### Facility Identification and Address

<<Insert Facility Name & Address>>

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### Purpose

To standardize the collection, testing, and screening of Special Operations Command (SOCOM) whole blood donors prior to deployment.

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DEPARTMENT OF THE  
HEADQUARTERS, UNITED STATES ARMY  
2748 WORTH ROAD  
FORT SAM HOUSTON, TX

REPLY TO  
ATTENTION OF

MCHO-CL-R

Army Blood Program Policy Letter 2016-03-01  
4 March 2016

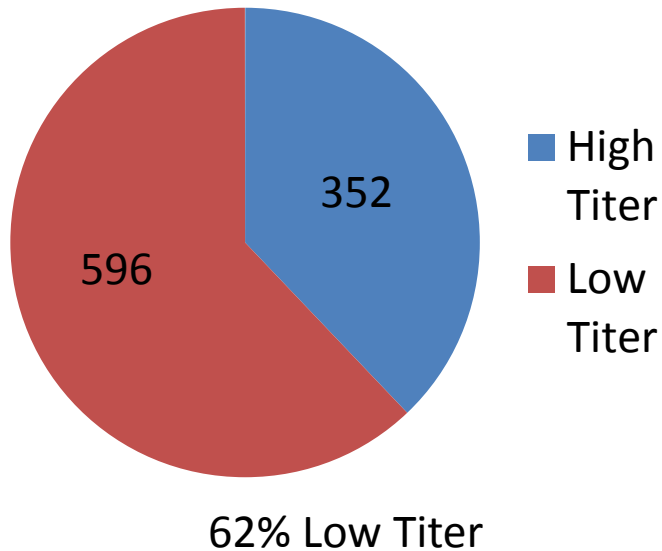
MEMORANDUM FOR ALL ARMY BLOOD DONOR CENTERS

SUBJECT: Procedures for the Screening of Special Operations (SO) Whole Blood Donors Prior to Deployment



# ROLO Pre-Screen Results

## ROLO



- 11 personnel with positive viral markers or antibody screens
- One individual confirmed positive for HCV
- Retest at 1 year interval
- 79 Re-titers
  - 10 Low to High
  - 6 High to Low



# ROLO Whole Blood Options

- Two options for providing ROLO Whole blood
- **Option 1:** Use of Low Titer Group O donor for Emergency FWB collection
- **Option 2:** Collection of Group O Low Titer WB Pre-Mission
- Pre-screen data is critical for either option
- Ranger Regiment medical staff have TMDS accounts to access donor information
  - TTD Results
  - Titer Results



# ROLO use in CENTCOM

- Ranger Regiment Surgeon coordinated with CENTCOM Blood Program for pre-mission collection of low titer Group O WB
- WB collected by Blood Support Detachment located at Bagram Airfield
- Rangers collected prior to high-risk missions
- Typically collected 2-4 units at a time 1 day prior to mission
- BSD collecting whole blood in CPDA-1 anticoagulant – 35 day expiration
- BSD followed JTS CPG procedure for donor collection to include:
  - DD572
  - Rapid Testing (HIV/HCV/HBV/RPR/Malaria)
  - Retrospective samples for send-out testing



# ROLO use in CENTCOM

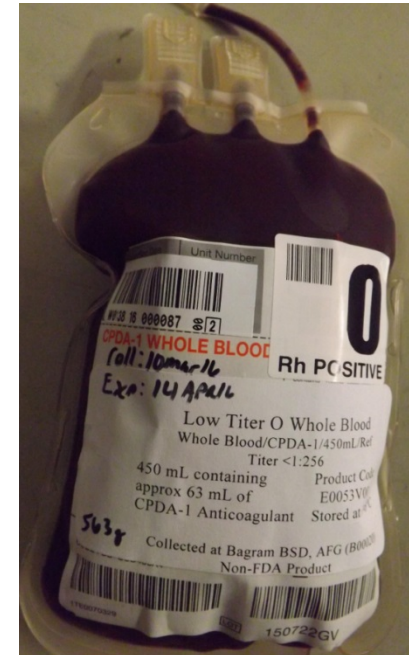
## LOW TITER O WHOLE BLOOD BLOOD PRODUCT ADMINISTRATION GUIDELINES

Blood Product Name: Low Titer O Whole Blood	Approved By: [REDACTED] JBPO	Page 1 of 2
Other Names: • ROLO WB	Date Approved: 29 February 2016	Document #: G.18-1A1
	Effective Date: 29 February 2016	Version#: 1

Classification/Indications	<p>Low titer O whole blood is to be used in resuscitation of bleeding patients in the pre-hospital setting.</p> <p>This product is collected from donors who have been pre-screened with FDA approved infectious disease testing and have been tested to determine an anti-A/B titer level of <math>\leq 1:256</math>.</p> <p>Low titer O is considered universal and may be administered for to all blood types.</p>
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Contraindications	<p>Do Not:</p> <ul style="list-style-type: none"> <li>• Use for non-bleeding patients</li> <li>• Use solely for volume expansion</li> </ul>
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Supplied	<ul style="list-style-type: none"> <li>• Volume is 450 mLs.</li> <li>• Hct 33%.</li> <li>• Whole Blood can be stored for 35 days 1 to 6°C.</li> <li>• Low Titer O Whole Blood will be drawn upon request and in quantities to support near term mission requirements.</li> </ul>
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# ROLO use in CENTCOM



First ROLO pre-mission collection performed on 9 March 2016



# ROLO WB Collections in CENTCOM

ROLO Pre-Mission WB Collections in CENTCOM	
# ROLO WB Units Collected	19
# ROLO WB expired/destroyed	11
# ROLO WB Transfused	1
# ROLO WB in Inventory	7

Data as of 12 Mar 2016



# Whole Blood Manufactured in CONUS

- CONOPS for Ranger use of WB was requiring more blood than ROLO donors could support
- Most ASBP donor centers are FDA licensed for Whole Blood Manufacture
- Army Blood Program established Whole Blood Production at Armed Services Blood Bank Center – Pacific Northwest, Joint Base Lewis McCord, WA
- Facility collects in Citrate Phosphate Dextrose (CPD) anticoagulant – 21 day expiration



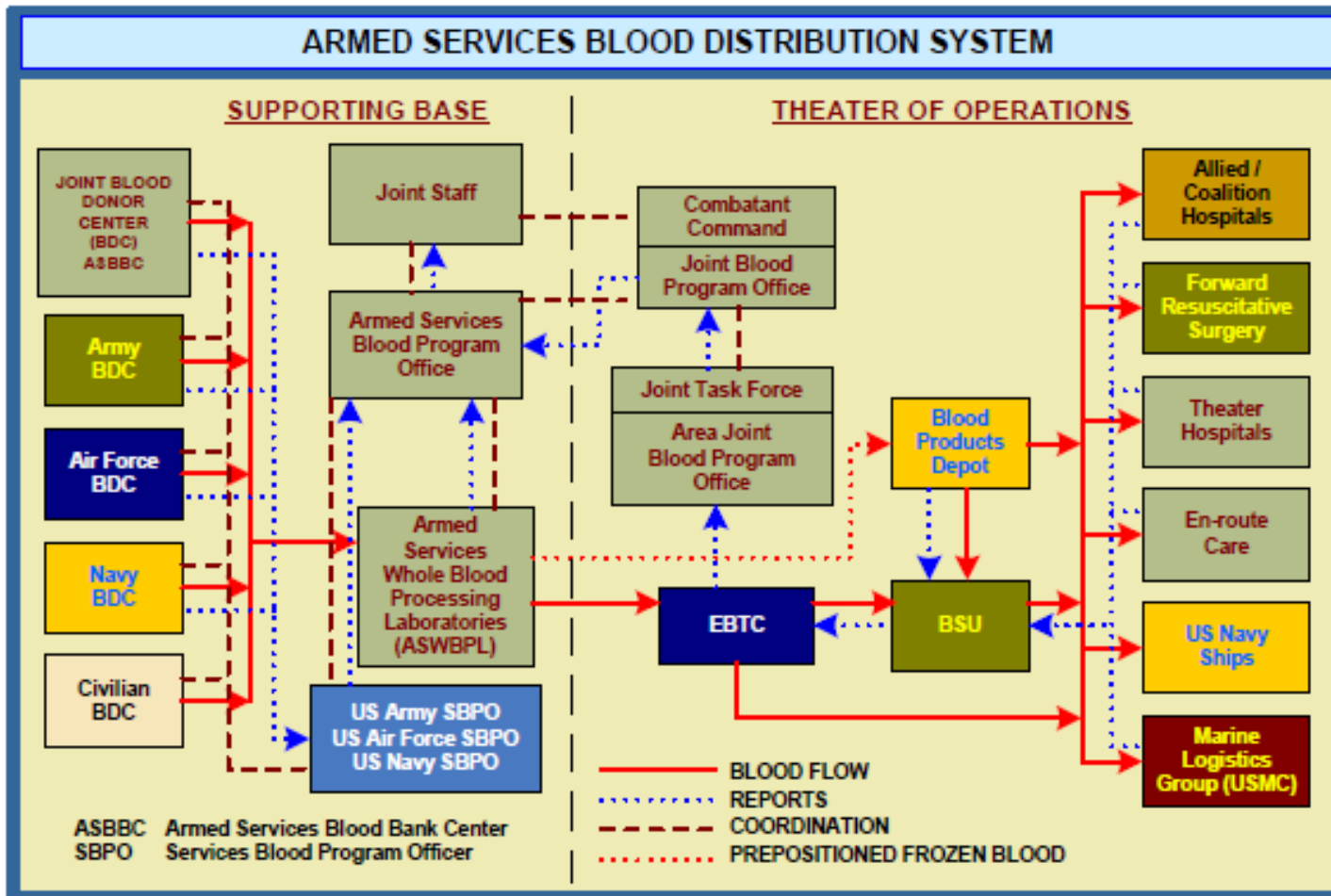


# ASBP Manufactured Whole Blood

- Product is FDA licensed and receives required testing prior to distribution
- Titer testing is sent out under a contracted testing service
- Titer Methodology: Tube, 1:150 saline dilution, immediate spin at RT
- Testing for IgM Anti-A and Anti-B
- Acceptable titer <1:150, each unit tested
- **21 Day Shelf Life for WB, RBC unit has 42 Day Shelf Life**



# CONUS Whole Blood Shipments



# CONUS Whole Blood Shipments

Licensed Low Titer O Whole Blood	
# WB Units Collected	36
# WB Units titer $\geq$ 1:150	4
# WB Shipped	29
# WB Transfused	2

23 March 2016 – date of first Whole Blood collection for production of low titer Group O Whole Blood

Currently ship 10 units every two weeks

7 days lost on shelf life by the time units arrive to AFG



# CONUS Whole Blood Shipments

- Armed Services Blood Program Office memo 11 Apr 2016
- Requesting each Service Blood Program to be capable of producing low titer Group O WB NLT 1 Oct 2016
- Most donor centers are licensed for Whole Blood production, but no longer produce it
- Requires SOP and labeling updates
- Requires identification of a titer testing service



DEPARTMENT OF DEFENSE  
ARMED SERVICES BLOOD PROGRAM OFFICE  
DEFENSE HEALTH HEADQUARTERS  
7700 ARLINGTON BLVD.  
FALLS CHURCH, VA 22042



REPLY TO  
ATTENTION OF

ASBPO

11 APR 2016

MEMORANDUM FOR: Army Blood Program  
Navy Blood Program  
Air Force Blood Program

SUBJECT: Low Titer Group O Whole Blood for Contingency Support

1. Low titer Group O Whole Blood (WB) is a blood product which has been tested and found to have anti-A/anti-B antibody titers of <1:256. This product may be given to a recipient of any ABO type during damage control resuscitation based on the Tactical Combat Casualty Care (TCCC) guidelines dated 2 June 2014. Low titer Group O WB may be supplied to far forward special operations medical teams or to Role of Care 2/3 facilities which lack apheresis platelets.

2. ASBPO requests each Service Blood Program to be capable of producing FDA licensed low titer Group O Whole Blood NLT 1 Oct 2016 at one or more of their blood donor centers to support our blood program. Each donated unit of whole blood must be tested and found to have anti-A and anti-B titers of <1:256 as per current guidelines. While ASBPO is not requesting the Service Blood Programs maintain a whole blood inventory for routine mission support, the Services have the discretion to utilize this product to augment local facility massive transfusion protocols when deemed appropriate by the medical director and service transfusion medical consultant.

3. ASBPO point of contact for this action is [REDACTED]

# Titer Testing

Titer Testing Comparison	
<u>ROLO Pre-Screen</u>	<u>Licensed WB</u>
Tube Method	Tube Method
Manual Serial Dilutions	Automated Serial Dilutions
RT Incubation 15 Min	No RT Incubation
Spin and Read for Agg	Spin and Read for Agg
Reported as highest dilution w/ agglutination	Only 1:150 dilution tested
IgM only	IgM only
<1:256 Acceptable	<1:150 Acceptable



# Titer Testing

- Almost all blood used in WWII was low titer O WB
- <1:256 cutoff titer used after severe reaction in 1944, units labeled low or high titer
- Korean War - Almost 400,000 units of group O WB used, no reactions attributed to low titer O WB
- Vietnam War – 230,323 WB units (all ABO groups) transfused Sep 1967 to Feb 1969
  - 1 case of AHTR caused by Group O WB unit labeled as high titer, used by mistake
- No acceptable titer standard from regulatory agencies (FDA, CAP, AABB, etc)
- ROLO program starting to initiate 1 year retesting
- **Current process reduces risk of morbidity and mortality**
- **Benefit of transfusing WB closer to POI where blood component therapy is unavailable outweighs risk of minor ABO incompatibility**



# Navy & Air Force Initiatives

- Navy Blood Program completed pre-screen for USS Boxer 13-14 Jan 2016
  - NMC San Diego donor center conducted blood drive with USS Boxer
  - Crew had medical history, ABO/Rh, TTD, and titer testing performed by donating whole blood
  - Testing results provided to USS Boxer Senior Medical Officer
  - IgM titer testing; <1:256 acceptable
- Air Force Blood Program coordinating with AF Special Operations to determine support requirements



# Way Ahead

## Current & Future Efforts

- Continued retesting of Ranger Regiment personnel to determine if titers change significantly
- Pre-screening program expanding to other USASOC Units
- ASBP formed Working Group to consider joint standardization of pre-screening program
- Cold stored apheresis platelets; IPT formed

## Questions

- Should Whole Blood be available at R2/R3 care or only in pre-hospital setting?
- Expansion of WB Donor Pre-Screening to conventional forces?
- Availability of licensed WB to conventional forces?
- Balancing traditional collection mission with whole blood pre-screen support
- Increased WB use balanced against increased blood product destructions
- DoD funded studies on titer testing and critical values?





# QUESTIONS

