20 August 2017

AABB Standards Committee,

The AABB-THOR Working Party is resubmitting its request to modify standard 5.15.1 to permit the use of low titer group O whole blood in massively bleeding patients whose ABO group might not be known. The proposal includes a background information document that provides a detailed rationale for suggesting this modification. The document reviews the historical use of whole blood, the high incidence of preventable civlian deaths per year in the US due to hemorrhage, a detailed discussion of the serological safety of low titer whole blood incuding the latest observations from civilian recipients of 3&4 units of this product, and the potential benefits of using low titer group O whole blood to improve outcomes for patients with hemorrhagic shock. The background document also addresses the lack of consistency between the standards regarding minor incompatible plasma transfusion in plasma and platelets and that in whole blood.

To address the concern that there is not widespread interest in transfusing low titer whole blood in massively bleeding civilian recipients, the working party assembled a petition that was signed by 214 thought leaders in transfusion medicine, surgery, critical care, and emergency medicine from 24 countries. By signing the petition, these thought leaders expressd their interest and support of the use of low titer group O whole blood for massively bleeding patients whose ABO group might not be known. The petition has been signed by leaders in the transfusion medicine community including, amongst many others: Jim AuBuchon, Neil Blumberg, Michael Busch, Robertson Davenport, Larry Dumont, Jose Cancelas-Perez, Cassandra Josephson, Louis Katz, Harvey Klein, Jeff McCullough, Paul Ness, Adrian Newland, Mary Oneill, John Roback, Beth Shaz, Christopher Silliman, Simon Stanworth, Ronald Strauss, Marie Steiner, Darrell Triulzi, and Jonathan Wallis. This proposal to modify standard 5.15.1 is also endorsed by the following blood collectors: American Red Cross Biomedical Services, BloodWorks Northwest, Mississippi Valley Regional Blood Center, New York Blood Center, and by the UT Health San Antonio Trauma Center and the Eastern Association for the Surgery of Trauma. Their letters of support are attached.

Respectfully,

Philip C. Spinella, MD, FCCM
Co-Chair, AABB-THOR Working Party
Co-Chair, THOR Network
Professor, Department of Pediatrics
Washington University in St Louis, St Louis, MO

Mark Yazer, MD
Co-Chair, AABB-THOR Working Party
Professor of Pathology, University of Pittsburgh
Medical Director, RBC serology reference laboratory, Centralized Transfusion Service
Associate Medical Director, Centralized Transfusion Service
Adjunct Professor of Clinical Immunology, University of Southern Denmark

Executive Summary of Background Document

The AABB/THOR working party (WP) is suggesting that the AABB Standards Committee modify standard 5.15.1 to permit the use of low titer, group O whole blood (WB) in all massively bleeding patients regardless of their ABO group. Improved resuscitation strategies are needed for patients with life-threatening hemorrhage since there are approximately 30,000 preventable deaths after injury per year in the US, with 25,000 of these occurring prehospital. Data indicates that reconstituted whole blood in a 1:1:1unit ration reduces death from hemorrhage. Prehospital use of blood products within 30 min of injury also improves survival mortality is increased by 5% for every minute that initiating transfusion is delayed. Low titer group O whole blood has advantages over reconstituted whole blood as highlighted below. More than 210 experts from 24 countries have signed the WP's petition to support the modification of standard 5.15.1 to permit the use of low titer, group O WB in massively bleeding patients.

Benefits of Low Titer Group O Whole Blood Compared to Blood Components for Hemorrhagic Shock

Efficacy

- The cold stored platelets provide improved hemostasis compared to room temperature platelets
- More concentrated product that contains less anticoagulants and additive solution than an equal amount of components

Safety

- Reduced risk of hemolysis from the low titer minor incompatible plasma compared to the risk from untitered minor incompatible plasma or platelets
- Reduced risk of bacterial contamination compared to room temperature stored platelets
- Impressive safety record with over 1 million units transfused in combat and civilian settings

Logistic

- Increased access to platelets for both pre-hospital and early in-hospital resuscitations
- Simplifies and accelerates the provision of all blood components needed to treat hemorrhagic shock

Joint AABB-THOR Working Party Petition

The following individuals endorse the following statement:

"Do you agree that AABB standards should allow for uncrossmatched, low titer, group O WB to be used in the resuscitation of massively bleeding patients whose ABO group might not be known at the time of WB transfusion?"

1. **Sasha D Adams, MD**
   UT Health, Houston. Asst Professor Surgery
   6431 Fannin Street, MSB 4.282. Houston, TX 77030
   sasha.d.adams@uth.tmc.edu

2. **Jason Acker, BSc MSc MBA PhD**
   Senior Research Scientist - Canadian Blood Services
   Professor - Laboratory Medicine and Pathology, University of Alberta
   acker@blood.ca

3. **Louis Alarcon, MD, FACS, FCCM**
   Professor of Surgery and CCM
   Medical Director, Trauma Surgery
   University of Pittsburgh School of Medicine
   F-1264, UPMC-Presbyterian
   200 Lothrop St.
   Pittsburgh, PA 15213
   412-647-1158
   alarconl@upmc.edu

4. **Shubha Allard MD FRCP FRCPath**
   Consultant Haematologist
   Barts Health NHS Trust and NHS Blood and Transplant
   shubha.allard@nhsbt.nhs.uk

5. **Arwa Z. Al-Riyami, BS.c, MD, FRCPC**
   Senior Consultant Hematopathologist
   Department of Haematology, Sultan Qaboos University Hospital
   PO Box 38, PC 123, Muscat, Oman
   arwa.alriyami@gmail.com

6. **Torunn Oveland Apelseth, MD, PhD**
   Senior Consultant
   Department of immunology and transfusion medicine
   Haukeland University Hospital, N-5021 Bergen, Norway
   torunn.oveland.apelseth@helse-bergen.no

7. **James P. AuBuchon, MD**
   Bloodworks

921 Terry Ave, Seattle, WA 98104
jima@bloodworksnw.org

8. **Sylvain Ausset MD**
Professor & Chair of anaesthesia & intensive care
HIA Percy. 92140 Clamart. France
sylvain.ausset@gmail.com

9. **Ivar Austlid, MD**
Anaesthesiologist Consultant
Nordre Hauglandshella 31, 5314 Kjærrgarden, Norway
iaust@live.com

10. **Andrew N. Beckett, CD MD FRCS(C) FACS**
Assistant Professor of Surgery, McGill University
LTC, Royal Canadian Army Medical Corps
Montreal General Hospital
Andrew.beckett@mcgill.ca

11. **Rachel Beddard, MD**
Medical Director, BioBridge Global
6211 IH10 West, San Antonio, Texas 78201
rachel.beddard@biobridgeglobal.org

12. **Alec C. Beekley, MD**
Professor of Surgery, Sidney Kimmel Medical College at Thomas Jefferson University
1100 Walnut Street, Philadelphia, PA 19107
alec.beekley@jefferson.edu

13. **LTC Carmen Bell**
Deputy for Operations
US Armed services blood procurement office

14. **SGT Vincent Bennell**
4 Pages Close, Wymondham, Norfolk, NR18 0TU
vmbennell@yahoo.co.uk

15. **Olle Berséus, MD, PhD**
Specialist in Transfusion Medicine
FoU Department, Örebro University Hospital, Örebro, Sweden.
Consultant in transfusion Medicine to the Swedish Armed Forces.
Örtenlundsv. 7, 702 30 Örebro, Sweden
berseus@telia.com

16. **Marsha Bertholf, M.D.**
Medical Director
Gulf Coast Regional Blood Center
mbertholf@giveblood.org

17. **Kenneth A. Bertram, MD PhD FACP**
Principal Assistant for Acquisition
US Army Medical Research and Materiel Command
Ft Detrick, MD 21702
kenneth.a.bertram.civ@mail.mil

18. **Per Olav Berve, MD**
Consultant anaesthesist
Oslo University Hospital, air amb div
Lysgata 14, 1482 Nittedal
poberve@gmail.com

19. **Charlene Bierl, MD, PhD**
Director of the Clinical Laboratory
Cooper University Hospital
Camden, NJ 08103
bierl-charlene@CooperHealth.edu

20. **Geir Bjerkan, MD, PHD**
St. Olavs University Hospital and Norwegian Armed Forces, Joint Medical Services
Dalhaugveien 53, 7020 Trondheim
gbjerkan@hotmail.com

21. **Christopher Bjerkvig, MD**
Norwegian Special Forces Medical Service
Christopherbjerkvig@me.com

22. **Neil Blumberg, MD**
Professor of Laboratory Medicine
Director of Transfusion Medicine / Blood Bank
University of Rochester Medical Center
Neil_Blumberg@urmc.rochester.edu

23. **COL Milos Bohonek, MD, PhD**
Military University Hospital Prague, Czech Republic
U Vojenske nemocnice 1200, 16902 Prague, Czech Republic
milos.bohonek@uvn.cz

24. **Matthew A. Borgman, MD, FCCM, CHSE**
Chief, Pediatric Critical Care Services
Medical Director, BAMC Simulation Center
Associate Professor of Pediatrics, Uniformed Services University
Brooke Army Medical Center
MCHE-ZDP/PICU
3551 Roger Brooke Dr.
JBSA Ft. Sam Houston, TX 78234
matthew.a.borgman.mil@mail.mil

25. **LT COL Matt Boylan, FRCEM RAMC**
Consultant Advisor PHEM (British Army)
RCDM, Birmingham. UK
m.boylan@nhs.net

26. **Marshall Keith Brown, DO**
FAAFP; A. Prof UNMC, Medical Director Alpha Medical Inc.
401 E 8th St Ste 214-953, Sioux Falls SD 57103
drkeithbrown@gmail.com

27. **Michael P. Busch, MD, Ph.D.**
Director, Blood Systems Research Institute
Senior Vice President, Blood Systems
Professor of Laboratory Medicine, UCSF
mbusch@bloodsystems.org

28. **Becky Butler Cap, MBA**
Chief Operating Officer, South Texas Blood and Tissue Center
6211 IH 10 West, San Antonio, TX 78201
becky.cap@gencure.org

29. **Frank K. Butler, MD**
CAPT MC USN (ret)
Chairman, Committee on TCCC
Chief, Prehospital Trauma Care, Joint Trauma System
Adjunct Professor of Military and Emergency Medicine
Uniformed Services University of the Health Sciences
4575 Lavallet LnPensacola, Florida 32504
fkb064@yahoo.com

30. **David Callaway, MD**
Director, Division of Operational and Disaster Medicine
Associate Professor, Emergency Medicine
Department of Emergency Medicine, Carolinas Medical Center
1528 Dilworth Rd, Charlotte, NC 28203
dcallawa@gmail.com

31. **Jose Cancelas-Perez, MD**
Director, Research Division and Medical Director for Cell Therapies, Hoxworth Blood Center
Deputy Director, Hoxworth Blood Center
Leader, Stem Cell Program
Incumbent, Beatrice C. Lampkin Endowment for Stem Cell and Hematotherapy
Cincinnati Children's
Jose.Cancelas@cchmc.org

32. **Jeremy W. Cannon, MD, SM**
Associate Professor of Surgery, University of Pennsylvania

51 N. 39th Street, MOB 120 Philadelphia, PA 19104
jeremy.cannon@uphs.upenn.edu

33. **COL Andrew P. Cap, MD, PhD, FACP**
Medical Corps, US Army
Chief, Blood Research, US Army Institute of Surgical Research
Medical Director, Akeroyd Blood Donor Center
Associate Professor of Medicine, Uniformed Services University
Program Director, Clinical Research Fellowship
Deputy Hematology-Oncology Consultant to the Surgeon General
Staff Hematologist-Oncologist, San Antonio Military Medical Center
andrew.p.cap.mil@mail.mil

34. **D. Joe Chaffin, MD**
VP/Chief Medical Officer
LifeStream Blood Bank, San Bernardino, CA
Creator and Editor, BBGuy.org
joe.chaffin@bbguy.org

35. **Jill M Cholette, MD**
Associate Professor of Pediatrics
University of Rochester
Rochester NY
Jill_Cholette@URMC.Rochester.edu

36. **Joan Cid, MD, PhD**
Apheresis & Cellular Therapy Unit
Department of Hemotherapy and Hemostasis, ICMHO
Hospital Clínic
Villarroel 170
08036 Barcelona (Catalonia, Spain)
jcid@clinic.cat

37. **Franklyn Cladis, MD FAAP**
Associate Professor of Anesthesiology
Program Director,
Pediatric Anesthesiology Fellowship
The Children's Hospital of Pittsburgh of UPMC
CladFP@UPMC.EDU

38. **Claudia S. Cohn, MD, PhD**
Associate Professor
Medical Director, Blood Bank
Associate Head of Clinical Laboratories
University of Minnesota
cscohn@umn.edu

39. **Brian Cornelius DNP CRNA NRP**
University Health-Shreveport
1541 Kings Hwy Shreveport LA 71103
Brian.cornelius@uhsystem.com

40. **LTC Jason B. Corley**
Deputy Director, Army Blood Program
jason.b.corley.mil@mail.mil

41. **Brian Cornelius, DNP CRNA NRP**
University Health
9422 Milbank Dr Shreveport, LA 71115
Brian.cornelius@uhsystem.com

42. **Bryan A. Cotton, MD, MPH**
Professor of Surgery and The John B Holmes Professor of Clinical Sciences
Director, Surgical Critical Care, Acute Care Surgery and Trauma Fellowships
Department of Surgery and The Center for Translational Injury Research
McGovern Medical School at The University of Texas Health Science Center
Houston, Texas
Bryan.A.Cotton@uth.tmc.edu

43. **Jon B. Christensen, APA-C, HMO, FAWM, DiMM**
Chief of Medical Training for International Special Training Centre/ OIC of NATO Special Operations Combat Medic course.
CMR 445 Box GD. ISTC APO, AE 09046
Medchief@istc-sof.org

44. **Melissa Cushing, MD**
Associate Professor/Weill Cornell Medicine/NewYork-Presbyterian Hospital
525 East 68th St, Box 251, Blood Bank,NY, NY 10065
mec2013@med.cornell.edu

45. **Robertson D. Davenport, MD**
Professor of Pathology
Director, Transfusion Medicine
University Hospital 2G332/5054
1500 E. Medical Center Dr.
Ann Arbor, MI 48109-5054
rddvnprt@umich.edu

46. **Vincenzo De Angelis, MD**
Director Transfusion Medicine Dept.
Azienda Sanitaria Universitaria Integrata
S. Maria della Misericordia" - UDINE
P.le S. Maria della Misericordia, 15 - 33100 UDINE (Italy)
M vincenzo.deangelis@asuiud.sanita.fvg.it

47. **Meghan Delaney, DO**
Chief, Pathology & Laboratory Medicine
Children's National Health System
111 Michigan Ave NW
Washington DC, 20010
mdelaney2@childrensnational.org

48. **Gregory A Denomme, PhD, FCSMLS(D)**
Senior Investigator, Blood Research Institute
Senior Director, Immunohematology and Innovation
BloodCenter of Wisconsin
638 N 18th Street
PO Box 2178
Milwaukee, WI 53201-2178
Gregory.Denomme@BCW.edu

49. **Marc De Pasquale, BS**
18D Special Forces Medic
Paramedic NREMT
Deployment Medicine International
mxdxpx@yahoo.com

50. **Allan Doctor, MD**
Washington University in St. Louis / Professor of Pediatrics and Biochemistry
Campus Box 8208 / 660 S Euclid Street / Saint Louis, MO / 63108
doctor@wustl.edu

51. **Thomas Dolven, MD**
Consultant in Anesthesia and Intensive Care
Kalfarveien 108A, 5022 Bergen, Norway
thomasdolven@gmail.com

52. **Heidi Doughty, MD MBA FRCP FRCPath**
Consultant in Transfusion Medicine
NHS Blood and Transplant
UK

53. **Leilani Doyle, BSc MSc MD**
Associate Professor University of Ottawa, Royal Canadian Medical Corp Anesthesiologist
411 Ravenhill Ave Unit C K2A0J7
ldoyle@Ottawahospital.on.ca

54. **Larry J. Dumont, MBA, PhD**
Associate Director and Senior Investigator
Blood Systems Research Institute – Denver
c/o Bonfils Blood Ctr.
717 Yosemite Street

Denver, CO 80230Office: 303-363-2401
ldumont@bloodsystems.org

55. **Nancy M. Dunbar, MD**
Associate Professor
Geisel School of Medicine
Department of Pathology and Laboratory Medicine
Department of Medicine
Medical Director, Blood Bank
Associate Medical Director, Transfusion Medicine Service
Nancy.M.Dunbar@hitchcock.org

56. **David Duncan, MD**
Medical Director: CALSTAR Air Ambulance, Medical Director: CAL FIRE
6952 Kayo Drive, Penryn, CA 95663
daveduncanmd@gmail.com

57. **Richard P. Dutton, MD MBA**
Chief Quality Officer, US Anesthesia Partners
Dallas, TX
Richard.dutton@usap.com

58. **Torsten Eken, MD PhD**
Consultant anaesthesiologist, Oslo University Hosiptal, and Researcher in traumatology
University of Oslo
Oslo University Hospital Ullevål, Dept. of anaesthesiology
PO Box 4956 Nydalen, NO-0424 Oslo, Norway
torsten.eken@medisin.uio.no

59. **Håkon Eliassen**
Norwegian Special Forces Medical Service
Norway
hskogran@hotmail.com

60. **CAPT Roland Fahie**
Director, US Armed Services Blood Procurement Office

61. **Andrew D. Fisher, MPAS, PA-C**
PA-C, US Army Reserve, Major
andrewdfisher@icloud.com

62. **G. Michael Fitzpatrick, PhD, COL (Ret.) USA**
President
Director Clinical Research and Development, Cellphire Inc.
9430 Key West Ave Suite 204
Rockville. MD 20850
mfitzpatrick@cellphire.com

63. **Steven M. Frank, MD**
Director PBM Program / Johns Hopkins / Professor
1800 Orleans Street, Zayed 6208, Baltimore, MD 21287
sfrank3@jhmi.edu

64. **Alan I. Frankfurt, MD**
Anesthesiologist
7626 Caillet Street
F7040@aol.com

65. **Barbara A. Gaines, MD**
Professor of Surgery
University of Pittsburgh School of Medicine
Director, Trauma and Injury Prevention
Clinical Director, Division of General and Thoracic Surgery
Program Director, Pediatric Surgery Training Program
Children's Hospital of Pittsburgh of UPMC
gainesba@upmc.edu

66. **Pr. Olivier Garraud, MD PhD**
Senior Consultant
International Affairs
INTS - Institut National de la Transfusion Sanguine
6 rue Alexandre-Cabanel - 75739 PARIS cedex 15 - France
ogarraud@ints.fr

67. **Eric A. Gehrie, MD**
Assistant Professor, Pathology
Johns Hopkins University
Associate Director, Transfusion Medicine
Johns Hopkins Hospital
egehrie1@jhmi.edu

68. **Karen Giordano**
KGiordano@cerus.com

69. **Melissa Givens, MD MPH**
Associate Professor Department of Military and Emergency Medicine, Uniformed Services University
4117 Jones Bridge Road, Chevy Chase MD
melissa.givens@usuhs.edu

70. **Jacob Glaser, MD**
Critical Care and Trauma Surgeon, Naval Medical Research Unit San Antonio
3503 Puesta De Sol San Antonio TX 78261
jacob.glaser1@gmail.com

71. **COL Elon Glassberg, MD**
Professor of Surgery
IDF medical corps headquarters, Israel
edoc11@gmail.com

72. **Sherry Glenn, CLS(ASCP)SBB**
Major
311 Foxglove Path, San Antonio, TX 78245
Sherry.d.glenn.mil@mail.mil

73. **Ruchika Goel, MD MPH**
New York Presbyterian Hospital, Weill Cornell Medicine, Assistant Medical Director of TM/CT, Assitant professor
525 East 68th Street, M-014, New York Presbyterian Weill Cornell.
ruchikagoel1@gmail.com

74. **Samantha Gomez Ngamsuntikul, MD**
Associate Medical Director
6211 IH 10 W, San Antonio TX 78201
samantha.ngamsuntikul@biobridgeglobal.org

75. **Richard Gonzales, MS**
Director, TerumoBCT, COL, US Army , MT(ASCP)SBB
440 Devine Road, Olmos Park, TX 78212
Richard.gonzales@terumobct.com

76. **Dr Laura Green, MBBS, MD(Res), FRCP, FRCPath**
Barts Health NHS Trust and NHS Blood and Transplant, London, United Kingdom
laura.green@bartshealth.nhs.uk

77. **Ronald I. Gross, MD, FACS**
Chief, Division of Trauma, Acute Care Surgery & Surgical Critical Care Baystate Medical Center
759 Chestnut Street, Springfield, MA 01199
ronald.gross@baystatehealth

78. **James Richard Gruenewald APA-C, MPAS**
Deputy Regiment Surgeon/160th Special Operations Aviation Regiment (Abn)/Captain
1149 North Ja Tate Drive Clarksville, TN 37043
jimmygruenewald@gmail.com

79. **Mark W. Hall, MD**
Chief, Division of Critical Care Medicine, Nationwide Children's Hospital
Nationwide Children's Hospital, 700 Children's Drive, Columbus, OH. 43205
Mark.Hall@nationwidechildrens.org

80. **Judith Hannon, MD FRCPC**
Medical Officer, Canadian Blood Services, Edmonton, Alberta, Canada

Clinical Professor, University of Alberta, Edmonton, Alberta, Canada
8249-114 Street, Edmonton, Alberta, Canada, T6G 2R8
judy.hannon@blood.ca

81. **Sheila J. Hanson, MD, MS**
Associate Professor of Pediatrics
Associate Director, PICU
Children's Hospital of Wisconsin
shanson@mcw.edu

82. **Sarah K Harm, MD, MS**
Assistant Professor, Pathology
Robert Larner, M.D. College of Medicine @ UVM
Medical Director, Blood Bank
University of Vermont Medical Center
233 MP1, 111 Colchester Ave, Burlington, VT 05401

83. **John Andrew Harvin, MD**
Assistant Professor, UT Health
6431 Fannin Street, MSB 4.294 Houston, TX 77030
John.Harvin@uth.tmc.edu

84. **Tor Hervig, MD**
Overlege
Helse Førde HF
Norway
tor.audun.hervig@helse-bergen.no

85. **Luis Alfredo Perez Bolde Hernandez**
Lieutenant Col. Medicina Tactica Mexcio
calle cantil 31 D fracc.cañada de la bufa, guadalupe Zacatecas C.P. 98613 mexico
director@medtacmex.org.mx, hypermed@gmail.com

86. **CDR Jonathan Hoiles, MSC, USN**
Branch Head, Navy Blood Program

87. **John Holcomb, MD**
Professor of Surgery, UT Health, Houston TX
Suite 1100, 6410 Fannin, Houston, TX, 77030
john.holcomb@uth.tmc.edu

88. **Eirik Holmstrøm, EMT-P/Flight P/CCATT MCD**
AOIC-Instructor / ISTC NSOCM /CPT
Passebekkv. 546, 3648 Passebekk, Norway
eirik@holmy.no

89. **Greggory J. Housler, MScEng, MBA**
Product Manager, Blood Products

US Army Medical Materiel Development Activity (USAMMDA) Pharmaceutical Systems Program Management Office (PSPMO)
1430 Veterans Drive, Room 312
Fort Detrick, MD 21702-5009
greggory.j.housler.civ@mail.mil

90. **Beverley J Hunt, FRCP, FRCPath, MD**
Thrombosis & Haemostasis, King's College
Consultant, Depts of Haematology & Pathology,
Clinical Lead in Haematological Laboratories
Guy's & St Thomas' NHS Foundation Trust & Viapath
Westminster Bridge Road
London SE1 7EH
Beverley.Hunt@gstt.nhs.uk

91. **Fabian Hurbin**
NR-P / Lieutenant
Weidstrasse 27, CH-4317 Wegenstetten, Switzerland
fabian.huerbin@vtg.admin.ch

92. **Donald H. Jenkins, MD, FACS**
Professor/Clinical, Division of Trauma and Emergency Surgery
Vice Chair for Quality, Department of Surgery
Betty and Bob Kelso Distinguished Chair in Burn and Trauma Surgery
Associate Deputy Director, Military Health Institute
UT Health San Antonio
7703 Floyd Curl Drive
San Antonio, TX 78229-3900
Jenkinsd4@uthscsa.edu

93. **Bryon P. Jackson Sr., MD, MHA**
Assistant Professor of Pathology
Emory University School of Medicine
Medical Director Blood and Transfusion Services
Grady Memorial Hospital
bryon.patrick.jackson@emory.edu

94. **Timo Jama, MD, MSc (disaster medicine)**
Medical Director of EMS
Keskussairaalankatu 7, 15850 Lahti, FINLAND
timo.jama@phhyky.fi

95. **Dennis Jarema, 18D RN**
18D/ USSOCOM/ SSG
2103 Stonewall Farms dr
dmjarema@hotmail.com

96. **David Jobes, MD**
Prefessor of Anesthesia and Critical Care; the Chidlren's Hospital of Philadelphia and the Perelman
School of Medicine at the University of Pennsylvania
the Children's Hospital of Philadelphia; 34th Civic Center Blvd; Phila. PA
jobes@email.chop.edu

97. **George A. Johnson, MSN**
Landstuhl Regional Medical Center/212th Combat Support Hospital/LTC
CMR 422, BOX 398, APO, AE 09067
george.johnson1900@gmail.com

98. **Cassandra D. Josephson, MD**
Professor, Pathology and Pediatrics, Emory University School of Medicine
Director of Clinical Research, Center for Transfusion and Cellular Therapies
Program Director, Transfusion Medicine Fellowship
Medical Director, Children's Healthcare of Atlanta Blood, Tissue, and Apheresis Services, Atlanta, GA
cjoseph@emory.edu

99. **Shawn F. Kane, MD FAAFP, FACSM**
COL, MC, MFS, DMO
Commander, Special Warfare Medical Group (Airborne)
Dean, Joint Special Operations Medical Training Center
Family Medicine Consultant to The Surgeon General
shawn.kane@socom.mil

100. **Matthew S. Karafin, MD, MS**
BloodCenter of Wisconsin
638 N 18th Street, Milwaukee WI 53201
matthew.karafin@bcw.edu

101. **Oliver Karam, MD, PhD**
Children's Hospital of Richmond at VCU
1250 E Marshall St, Richmond, VA 23298
oliver.karam@vcuhealth.org

102. **Jeffry Kashuk, MD**
Professor of Surgery, Tel Aviv- Sackler SOM
Habarzel 11 Suite 5A TelAviv Israel
Jeffrykashuk@gmail.com

103. **Louis M. Katz, MD**
Interim Chief Executive Officer
Chief Medical Officer
America's Blood Centers
725 15th St. NW, suite 700
Washington DC, 20005

Adjunct Clinical Professor
University of Iowa, Carver College of Medicine, Division of Inf. Dis.
lkatz@americasblood.org

104. **Sean Keenan, MD, FAAEM FAWM**
US Special Operations Command
USA
dockeenan95@aol.com

105. **Jeffrey D. Kerby, MD, PhD**
Professor and Director, Acute Care Surgery, University of Alabama at Birmingham
KB 120, 1720 2nd Avenue South, Birmingham, Alabama 35294-0016
jkerby@uabmc.edu

106. **Harvey G. Klein, MD**
Chief, Department of Transfusion Medicine
Clinical Center
National Institutes of Health
Adjunct Professor of Medicine and Pathology
The Johns Hopkins School of Medicine

107. **Fredrik Koller Lund, MD EDIC**
Consultant intensivist/ anesthesiologist
Haukeland University Hospital, 5021 Bergen, Norway
fredrik.koller.lund@gmail.com

108. **Justina Kordai Ansah, MCChB, CTM, FGCPS**
National Blood Service Ghana- Chief Executive Officer (C.E.O)
National Blood Service Ghana
GHANA
kordaiansah@yahoo.com

109. **Rosemary Kozar, MD PhD**
Professor of Surgery; Shock Trauma Center; University of Maryland
22 South Green St. Maryland, MD 21201
rkozar@umm.edu

110. **Robert Kramer, MD, FACS**
Clinical Associate Professor of SurgeryTufts University School of Medicine
Maine Medical Center 22 Bramhall St Portland Maine
kramer@mmc.org

111. **Oliver Kreuzer**
SAR Flight Paramedic, Air Zermatt / Flight Paramedic US ARMY Reserve
Heliport, 3920 Zermatt, Switzerland
oliver.kreuzer@air-zermatt.ch

112. **Einar K. Kristoffersen, MD, PhD**
Head of Department, Professor Univ. of Bergen
Department of Immunology and Transfusion Medicine, Bergen , Norway
einar.kristoffersen@helse-bergen.no

113. **Jens Kronborg, MD, PhD**
Chief Consultant, Dep of Immunology and Transfusion Medicine, Innlandet Hospital, Norway
Avd for blodbank og medisinsk biokjemi, Sykehuset Innlandet, 2629 Liullehammer, Norway
kronborg@bbnett.no

114. **John Lacroix, 68W**
US Army/68W/CoTCCC
1111 vista Valet SATX 78216
Jlcjohn83@gmail.com

115. **Sami Länkimäki**
South-Osthrobothnian Health Care Districr /M.D, Chief Physician for Prehospital Care
EPSHP, Ensihoitokeskus, Sami Länkimäki, Rengastie 13, 60100 Seinäjoki, Finland
Sami.lankimaki@epshp.fi

116. **Marcus Larsson, MD MSc**
Sunderby Hospital, Norrbotten County, Sweden
Havrevagen 20, 95432 Gammelstad, Sweden
marcus.o.c.larsson@gmail.com

117. **Fiona Lecky MB ChB,Ph D,FRCEM, FRCS**
University of Sheffield and Salford Royal/Clinical Professor&Honorary Consultant
CURE, HSR Section, School of Health and Related Research, University of Sheffield, Regent's Court, Regent Street, Sheffield S14DA
f.e.lecky@sheffield.ac.uk

118. **Parvez M. Lokhandwala, MBBS, PhD**
Assistant Professor, Division of Transfusion Medicine, Johns Hopkins University School of Medicine
550 N. Broadway Building, 8th Floor, Baltimore, MD 21205
PLOKHAN1@JHMI.EDU

119. **PauL Loos 18D**
JSOMTC Instructor
70 West Trafalgar Court
medguy21@gmail.com

120. **Joseph Love, DO MS FACS**
Associate Professor
6431 Fannin Street Houston texas
joseph.d.love@uth.tmc.edu

121. **Andrew I.R. Maas, MD, PhD**
Em Professo of Neurosurgery
University Hospital Antwerp
Wilrijkstraat 10
2650 Edegem - Belgium
andrew.maas@uza.be

122. **Professor Dr. med. Marc Maegele**
Klinik für Unfallchirurgie und Orthopädie
Klinikum Köln-Merheim (Cologne-Merheim Medical Center)
Universität Witten-Herdecke
Institut für Forschung in der Operativen Medizin (IFOM)
Ostmerheimerstr. 200, 51109 Köln
Marc.Maegele@t-online.de

123. **Kathryn Maitland**
Professor Paediatrics, Imperial College, London
KEMRI Wellcome Trust Research Programme, PO Box 230, Kilifi, Kenya
k.maitland@imperial.ac.uk

124. **Justin D. Manley, MD**
Major
809 Flowering Path, Niceville, FL 32578
docmanley@gmail.com

125. **COL Elizabeth Mann-Salinas, PhD, RN**
US Army Institute of Surgical Research, Colonel
335 Pershing Ave San Antonio, TX 78309
Elizmann@ gmail.com

126. **Prof. Noga Manny, MD**
Emeritus Associate Clinical Prof. of Internal Medicine (Hematology)
Hebrew University ,Jerusalem ,Israel.
Emeritus Medical Director of Hadassah Medical Center Blood Banks
Jerusalem ,Israel

127. **Marisa B. Marques, MD**
Transfusion Services Medical Director/UAB/ Professir of Pathology
619 19th Street South/P230G/Birmingham/AL 35233
mmarques@uabmc.edu

128. **Larry Martin, MD**
University of Mississippi Medical Center
2500 N. State St. Jackson, MS 39216
lmartin3@umc.edu

129. **Elisabeth Maurer, PhD**
Clin. Associate Prof., University of British Columbia; Chief Technology Officer, LightIntegra

Technology Inc.
330-2285 Clark Drive, Vancouver, BC, V5N 3G9
emaurer@lightintegra.com

130. **Jeffrey McCullough, MD**
Emeritus Prof university of Minnesota
7400 Shannon dr Edina MN 55439
mccul002@umn.edu

131. **Michael T. Meyer, MD, MS**
Chief, Pediatric Critical Care/Medical College of Wisconsin/Associate Professor
9000 West Wisconsin Avenue, M.S. #681 Milwaukee, WI 53226
mtmeyer@mcw.edu
Timothy Miller MB ChB FRCA
Associate Professor of Anesthesiology
Chief, Division of General, Vascular and Transplant Anesthesia
Director, Perioperative Medicine Fellowship
Duke University School of Medicine
timothy.miller2@duke.edu

132. **Ethan A Miles, MD**
LTC, US Army
Associate Proffessor, Uniformed Services University of the Health Sciences
ethanamiles@yahoo.com

133. **Ernest E Moore, MD**
University of Colorado Denver/Surgery/Professor
Journal of Trauma, 655 Broadway, Denver 80203
ernest.moore@dhha.org

134. **David S. Morris, MD**
5161 S. Cottonwood St. Murray UT 84107
davidstephenmorris@gmail.com

135. **Johan Storm Munch, MD**
LtCol
OPSTØ/Hæren, N-9325 Bardufoss, NORWAY
johmunch@bbnett.no

136. **Alan Murdock, MD**
Chief of Emergency Surgery, Allegheny General Hospital, Pittsburgh PA
320 E North Ave, 5th Fl South Tower, Suite 594
Alan.murdock@ahn.org

137. **Jennifer A Muszynski, MD, MPH**
Assistant Professor of Pediatrics, Division of Critical Care Medicine, Nationwide Children's Hospital and The Ohio State University College of Medicine

700 Children's Drive, Columbus Ohio 43205
jennifer.muszynski@nationwidechildrens.org

138. **Lena M. Napolitano, MD, FACS, FCCP, MCCM**
Massey Foundation Professor of Surgery
Division Chief, Acute Care Surgery
Director, Trauma and Surgical Critical Care
Acute Care Surgery [Trauma, Burn, Critical Care, Emergency Surgery]
Department of Surgery
University of Michigan Health System
lenan@umich.edu

139. **Matthew D. Neal, MD**
Assistant Professor of Surgery and Critical Care Medicine
Attending Surgeon, Division of Trauma and Acute Care Surgery
University of Pittsburgh Medical Center
F1271.2 PUH 200 Lothrop Street
Pittsburgh, PA 15213
nealm2@upmc.edu

140. **Marianne Nellis, MD, MS**
Assistant Professor
525 East 68th St, M512, NY, NY 10065
man9026@med.cornell.edu

141. **Andrea Neisser-Svae, PhD**
Octapharma, Head of Business Unit ICEM
Oberlaaerstrasse 235, A-1100 Vienna, Austria
andrea.neisser-svae@octapharma.com

142. **Paul M Ness, MD**
Director, Transfusion Medicine; Professor of Pathology and Medicine; Johns Hopkins Medical Institutions
Zayed 3081; Johns Hopkins Hospital: Baltimore MD 21287
pness@jhmi.edu

143. **Adrian Newland, CBE MA FRCP FRCPath**
Professor of Haematology
The Royal London Hospital
Barts Health NHS Trust
Pathology and Pharmacy Building
80, Newark Street
London, E1 2ES
a.c.newland@qmul.ac.uk

144. **Philip Norris, MD**
Senior Investigator

270 Masonic Ave., San Francisco, CA 94118
pnorris@bloodsystems.org

145. **COL (R) Adam Olszewski, MD**
Deputy Director Of Military Blood Center
00-671 Warsaw, Koszykowa 78
zdyrmed@wckik.pl
Poland

146. **E. Mary ONeill, MD**
Interim Chief Medical Officer
180 Rustcraft Rd, Dedham, Mass 02026
Mary.oneill@redcross.org

147. **Yaacov Orlin, MD**
Director of the Dept. of Transfusion Medicine
Maayane Hayeshua Medical Center
Bnei Brak, Israel
jerorlin@gmail.com

148. **Anand Padmanabhan, MD PhD QIA**
Medical Director, BloodCenter of Wisconsin
Associate Professor, Medical College of Wisconsin
Associate Investigator, Blood Research Institute
8733 Watertown Plank Road
Milwaukee, WI 53226-3548
anand.padmanabhan@bcw.edu

149. **Pierre Pasquier, MD**
HIA PERCY 101 avenue Henri Barbusse 92141 CLAMART
France
pasquier9606@me.com

150. **Heather Pidcoke, MD PhD**
Director, Global Clinical Safety&PRT Scientific Affairs/TerumoBCT
10810 West Collins Avenue, Lakewood, CO 80215
heather.pidcoke@terumobct.com

151. **Dr.med. Urs Pietsch / DESA / EDIC**
Kantonsspital St.Gallen, Switzerland
Institute of Anaesthesiology & Intensive Care Medicine, Air Zermatt, Switzerland , Consultant ICU
Air Zermatt, Heliport Raron, Switzerland
pietsch@gmx.de

152. **Timothy A Pritts, MD, PhD**
Professor of Surgery, University of Cincinnati
231 Albert Sabin Way, ML 0558, Cincinnati, Ohio 45268
prittsta@ucmail.uc.edu

153. **Naomi Rahimi-Levene, MD**
Director of the Blood Bank, Assaf Harofeh Medical Center, Zerifin, Israel
Member of the Transfusion Medicine Advisory Board to the Ministry of Health in Israel
Head of the Israeli Transfusion Medicine Study Group
nrlevene@asaf.health.gov.il

154. **Joseph Rappold, MD, FACS**
CAPT MC USN (Ret); Chief, Acute Care Surgery
Trauma Medical Director, Department of Surgery
Tufts University School of Medicine
Maine Medical Center
jrappold@mmc.org

155. **Jørn E Rasmussen**
Head of ED
Specialist in Internal medicine and Cardiologi.
Drammen Hospital Trust, Vestre Viken HF | www.vestreviken.no
Major, MD in Norwegian Armjed Forces.
Call: 7675
Mobilnr: +47 91720615
rasj@vestreviken.no

156. **Jay S. Raval, MD**
Assistant Professor
Department of Pathology and Laboratory Medicine
Director of Therapeutic Apheresis and Blood Donor Center
Associate Director of HPC Laboratories
jay_raval@med.unc.edu

157. **COL Michael Reade, MBBS MPH DPhil DMedSc FANZCA FCICM**
Level 9 Health Sciences Bldg, Royal Brisbane & Women's Hospital 4029
Australia
m.reade@uq.edu.au

158. **LT COL Rich Reed, FRCA RAMC**
16 Medical Regiment, Defence Medical Services, UK
Anaesthetic Department, Derriford Hospital, Plymouth, PL6 8DH, UK
richard.reed1@nhs.net

159. **Oliver Reisten, PhD**
Medical Director of Rescue Service Solothurn Hospitals, Consultant in Anaesthesia and Emergency Medicine
Allmendstrasse 61, CH-4612 Wange bei Olten, Switzerland
oliver.reisten@air-zermatt.ch

160. **Kenneth E. Remy, MD, MHSc**
Washington University in St. Louis
1 Children's Place St. Louis, MO 63005
kremy@wustl.edu

161. **Peter Rhee, MD, MPH, FACS, FCCM**
Senior Vice President
Chief of Acute Care Surgery and Trauma Medical Director
Grady Memorial Hospital
80 Jesse Hill Jr. Drive SE, Atlanta, Georgia 30303
prhee@GMH.EDU

162. **John D. Roback, MD, PhD**
Professor of Pathology and Laboratory Medicine
Medical Director, Emory Medical Laboratories
Vice-Chair, Clinical Pathology and Laboratory Medicine
Director, Center for Transfusion and Cellular Therapies
Emory University School of Medicine
EUH D-655, 1364 Clifton Rd NE
Atlanta, GA 30322
jroback@emory.edu

163. **Nareg Roubinain, MD**
Clinical investigator
Blood systems research institute
Nareg.Roubinian@ucsf.edu

164. **Rob Russell, MD, MPH**
Assistant Professor of Pediatric Surgery
Children's of Alabama
University of Alabama at Birmingham
1600 7th Ave. S., Lowder Building Suite 300
Birmingham, AL 35233
Robert.Russell@childrensal.org

165. **Anne Sailliol**
physician, specialist in hemobiology and transfusion expert.
Clamart.
France
anne.sailliol@wanadoo.fr

166. **Thomas M. Scalea, MD**
Physician in Chief,
R Adams Cowley Shock Trauma Center
Francis X Kelly Distinguished Professor of Trauma,
Director Program in Trauma
University of Maryland School of Medicine
System Chief for Critical care

University of Maryland Medical System
tscalea@umm.edu

167. **MAJ Jo Schmid, BScN, RN, CNCC(C)**
527 Gardner Cres, Petawawa, ON, K8H 0C4
Canada
jschmid817@hotmail.com

168. **Martin A. Schreiber, MD FACS**
Professor of Surgery
3181 SW Sam Jackson Park Road, Mail Code L611, Portland, OR 97239
schreibm@ohsu.edu

169. **C. William Schwab MD, FACS, FRCS (Glas)**
Emeritus Professor of Surgery
Perlman School of Medicine
University of Pennsylvania
Senior Consultant
Penn Medicine
Philadelphia,PA, USA
Charles.Schwab@uphs.upenn.edu

170. **Beth H Shaz, MD**
New York Blood Center, CMSO
310 E 67th St, NY, NY 10065
bshaz@nybc.org

171. **Forest Sheppard, MD**
Associate Professor of Surgery
Acute and Critical Care Surgery
Department of Surgery
Washington University
forest.r.sheppard@wustl.edu

172. **Eilat Shinar, MD**
Director, Magen David Adom in Israel
Tel HaShomer, Israel
eilats@mda.org.il

173. **Cees Th. Smit Sibinga, MD, PhD,FRCP Edinburgh, FRCPath (London)**
emProfessor of International Development of Quality Management in Transfusion Medicine, University of Groningen, Groningen, Nl.
Director IQM Consulting for International Development of Quality Management in Transfusion Medicine, Zuidhorn, NL
c.sibinga@planet.nl

174. **Jeffrey Siegler, MD**
EMS Physician, Instructor of Emergency Medicine

Washington University School of Medicine
Sieglerj@wustl.edu

175. **Christopher C Silliman, MD, PhD**
Professor of Pediatrics and Surgery
School of Medicine
University of Colorado Denver
Senior Independent Investigator
Research Department
Bonfils Blood Center
Attending Physician
Center for Cancer and Blood Disorders
Children's Hospital of Colorado
Christopher.Silliman@ucdenver.edu

176. **Sven Chr Skaiaa**
Consultant Anesthesiologist
University of Oslo, Air Amb dep.
Stupulvegen 5, 3560 Hemsedal, Norway
scskaiaa@gmail.com

177. **Surgeon Rear Admiral Jan Sommerfelt-Pettersen**
Surgeon Genereal
Norwegian Defence Joint Medical Service
Joint Medical Service, N-2058 Sessvollmoen, Norway
jan@sommerfelt-pettersen.no

178. **Jason L. Sperry, MD, MPH**
Professor of Surgery and Critical Care Medicine
Presbyterian Hospital, Suite F1268, 200 Lothrop Street, Pittsburgh PA 15213
sperryjl@upmc.edu

179. **Philip C. Spinella, MD, FCCM**
Professor of Pediatrics, Division of Critical Care Medicine
Director, Critical Care Translational Research Program
Washington University in St. Louis
USA

180. **Ulrik Sprogøe, MD, PhD**
Deputy Medical Director
Department of Clinical Immunology (part of South Danish Transfusion Service)
Odense University Hospital
DK-5000 Odense C
Denmark
ulrik.sprogoe@rsyd.dk

181. **Simon J Stanworth, DPhil MD**
Consultant Haematologist
NHS Blood and Transplant/
Oxford University Hospitals NHS Foundation Trust
Level 2, John Radcliffe Hospital
Honorary Senior Clinical Lecturer,
University of Oxford
simon.stanworth@nhsbt.nhs.uk

182. **Marie Steiner, MD, MS**
Professor, Pediatrics
MMC 484, University of Minnesota, Minneapolis, MN 55455
stein083@umn.edu

183. **Zsolt Stockinger, MD, FACS**
CAPT, MC, USN
Director, Joint Trauma System/Defence Center of Excellence for Trauma
Associate Professor of Surgery, Uniformed Services University of Health Sciences
3698 Chamber Pass, STE B
JBSA Fort Sam Houston, TX 78234-7767
210-539-9174 DSN 389
zsolt.t.stockinger.mil@mail.mil

184. **Geir Strandenes, MD, SMO NORNAVSOC**
Senior Medical Officer, Norwegian Naval Special Operation Commando
Researcher, Department of Immunology and Transfusion Medicine
Haukeland University Hospital
Norway
geir@docfish.no

185. **Ronald G. Strauss, MD**
Professor Emeritus Departments of Pathology & Pediatrics University of
Iowa College of Medicine Associate Medical Director,
Associate Medical Director, LifeSource/ITxM
rstrauss@itxm.org

186. **Paul Stricker, MD**
Associate Professor of Anesthesiology and Critical Care, The Children's Hospital of Philadelphia and the Perelman School of Medicine at the University of Pennsylvania
3401 Civic Center Blvd, Philadelphia, PA 19104
strickerp@email.chop.edu

187. **James R. Stubbs, MD**
Consultant, Department of Laboratory Medicine and Pathology
Chair, Division of Transfusion Medicine
Mayo Clinic
200 First Street SW

Rochester, Minnesota, 55905
stubbs.james@mayo.edu

188. **Marius Svanevik, MD**
Vestfold Hospital Trust (Consultant Gastrointestinal Surgery)
Norwegian Army NorSOST, SMO (OF-3)
drsvanevik@hotmail.com

189. **Joseph Sweeney, MD**
Director, Transfusion Medicine
Professor, Brown University
The Miriam Hospital
164 Summit Ave
Providence RI 02806
JSweeney@Lifespan.org

190. **Matthew Sztajnkrycer, MD, PhD**
Associate Professor of Emergency Medicine
Mayo Clinic, Rochester, MN
Sztajnkrycer.Matthew@mayo.edu

191. **Lt Cdr Øystein Tandberg, MD**
Dept of orthopedics, Haukeland University Hospital, Bergen – Norway
OT HUS, Jonas Lies vei 65, Bergen NO
oystein.tandberg@gmail.com

192. **Patrick Thompson**
Paramedic
United Kingdom
divemedicpatrick@yahoo.co.uk

193. **Isaiah R. Turnbull, MD, PhD**
Assistant Professor of Surgery
Department of Surgery
Barnes-Jewish Hospital
Washington University Medical Center
Campus Box 8109
Saint Louis, Missouri 63110-8109
iturnbull@wustl.edu

194. **Darrell J. Triulzi, MD**
Medical Director
Institute For Transfusion Medicine
3636 Blvd of the Allies Pittsburgh PA 15213
Director, Division of Transfusion Medicine
Department of Pathology
University of Pittsburgh
dtriulzi@itxm.org

195. **Gunnar Vangberg, MD, Maj**
Norwegian Armed Forces Joint Medical Forces
St. Olavs University Hospital, Trondheim, Norway
Gunnarvangberg@hotmail.com

196. **Adam M. Vogel, MD, FACS, FAAP**
Associate Professor, Surgery and Pediatrics Baylor College of Medicine and Texas Children's Hospital
6701 Fannin Street, Suite 1210 Houston, TX 77030
adamv@bcm.edu

197. **Ville Voipio, MD, SSAI-ECC**
HEMS-physician
Kipinämikontie 20, Oulu 90420, Finland
voipio@mac.com

198. **LT COL Jerome Vinluan**
Deputy for Policy
US Armed services blood procurement office

199. **Terje Wadahl**
Nurse Anesthesist
Head Nurse Norwegian Army/E8
terje@wadahl.org

200. **Kevin Ward, MD**
Department of Emergency Medicine
University of Michigan
Michigan Center for Integrative Research in Critical Care (MCIRCC)
USA

201. **Daniel R Walker, MD, MS, FCAP**
Col, USAF, MC, FS
Medical Director, Apheresis and Cellular Therapy, San Antonio Military Medical Center
Medical Director, Armed Services Blood Bank Center - San Antonio
Assistant Professor of Pathology, Uniformed Services University of the Health Sciences
clotmeister@outlook.com

202. **Jonathan Wallis, BA. Oxon, MB. BS. Lond, FRCP (UK), FRCPath.**
Consultant Haematologist
Head of Blood Transfusion Newcastle upon Tyne Hospitals UK (Regional Major trauma centre)
Chair of the National Blood Transfusion Committee, England
President of the British Blood Transfusion Society
Jonathan.Wallis@nuth.nhs.uk

203. **Elizabeth Waltman, MBA**
Chief Operating Officer, South Texas Blood and Tissue Center

Executive Director, Blood and Tissue Center Foundation
6211 IH-10 West, San Antonio, TX 78201
elizabeth.waltman@southtexasblood.org

204. **Agneta Wikman, MD, PhD**
Associate professor
Karolinska University Hospital and Karolinska Institutet
Transfusion Medicine L2:01, Karolinska 17176 Stockholm Sweden
Agneta.wikman@sll.se

205. **Rob Woods, MD MMEd FRCPC**
Emergency Physician & Trauma Team Leader - Saskatoon Health Region
STARS Transport Physician
Assistant Professor & Residency Program Director - Department of Emergency Medicine, College of Medicine, University of Saskatchewan
rob.woods@usask.ca

206. **LT COL Thomas Woolley, FRCA RAMC**
Defence Senior Lecturer in Trauma Anaesthesia
UK
tomwoolley@me.com

207. **Arino Yaguchi**
Tokyo Women's Medical University
8-1 Kawadacho, Shinjuku, Tokyo, 1620054, Japan
ayaguchi@twmu.ac.jp

208. **Vered Yahalom, MD**
Transfusion & Apheresis Services Director
Rabin Medical Center, Petah Tikva, Israel
veredya2@clalit.org.il

209. **Mark Yazer, MD**
Professor of Pathology, University of Pittsburgh
Medical Director, RBC serology reference laboratory, Centralized Transfusion Service
Associate Medical Director, Centralized Transfusion Service
Adjunct Professor of Clinical Immunology, University of Southern Denmark
3636 Blvd of the Allies
Pittsburgh PA 15213
myazer@itxm.org

210. **LTC Avraham Yitzhak, MD, MHA**
General Surgeon
Head of Trauma and Combat Branch
Israeli Defense Forces Medical Corps headquarters
Tel Hashomer, Ramat Gan
Israelayitzhak@gmail.com

211. **Pampee P. Young, MD, PhD**
Associate Professor
Medical Director, Transfusion Medicine
Department of Pathology, Microbiology, immunology
1161 21st Ave South, MCN C2217
Vanderbilt University Medical Center
Nashville, TN 37232
pampee.young@Vanderbilt.Edu

212. **Nicole Dodge Zantek, MD, PhD**
University of Minnesota, Associate Professor
University of Minnesota, 420 Delaware Street SE, MNC 609, Minneapolis, MN 55455
Zant0005@umn.edu

213. **Martin D. Zielinski, MD, FACS**
Professor of Surgery
Medical Director of Trauma Research
Division of Trauma, Critical Care, and General Surgery
Department of Surgery
Mayo Clinic
200 First Street SW
Rochester, MN
55902
Zielinski.Martin@mayo.edu

214. **Alyssa Ziman, M.D**.
Professor, Pathology and Laboratory Medicine
Division Chief, Clinical Laboratory Medicine
Medical Director, Clinical Laboratories, Ronald Reagan UCLA Medical Center
Medical Director, Transfusion Medicine
UCLA Health System
AZiman@mednet.ucla.edu

Proposal to modify Standard 5.15.1 to permit the use of low titer, group O whole blood in massively bleeding patients regardless of their ABO group

The AABB/THOR working party (WP) is suggesting that the AABB Standards Committee modify standard 5.15.1 to permit the use of low titer, group O whole blood (WB) in all massively bleeding patients regardless of their ABO group.

There is extensive literature and experience indicating that it is desirable and safe to use cold stored, low antibody titer WB early in the management of traumatic hemorrhagic shock.[1] Reports from the Korean war detailed the efficacy and safety of transfusing low titer Group O whole blood; in 1952 over 600,000 units of low titer (defined as <256) group O whole blood were transfused to combat casualties. Patients typically received 10-30 units of low titer, group O WB, and only 4 patients were noted to have post-transfusion hemaglobinuria, which might or might not have been related to the receipt of the WB.[1] During an approximately 18 month period during the Vietnam war, 230,323 WB units were transfused,[2] and only one hemolytic reaction to a group O unit was reported. In fact, this lone, non-fatal reaction only occurred because a labeled high titer group O unit was accidentally transfused to a group A recipient.[3]

The recent wars in Iraq and Afghanistan have highlighted the high mortality associated with traumatic hemorrhagic shock and provided the opportunity to reevaluate the potential benefits of WB resuscitation in this context. One analysis from Iraq indicated the use of WB was independently associated with improved 30 day survival compared to the use of blood components for US casualties with life-threatening hemorrhage.[4]

Reducing death from hemorrhage is essential since the mortality for patients with traumatic hemorrhagic shock is high (approximately 20%) and there are approximately 30,000 preventable civilian deaths due to traumatic hemorrhage per year in the US alone.[5] The rationale for the use of group O WB

early in the resuscitation of massively bleeding patients is multifactorial and has been recently reviewed.[5,6] Group O whole blood provides a balanced resuscitation that simultaneously addresses oxygen debt and coagulopathy, both of which are associated with high mortality in this population.[4,7,8] The use of a blood based transfusion strategy that approximates whole blood with 1:1:1 unit ratios has been shown to reduce death from hemorrhage in adult trauma patients.[4,8] Whole blood is a more concentrated product containing a smaller quantity of anticoagulant and preservative solutions compared to an equivalent amount of reconstituted WB from blood components.[4] The cold stored platelets in WB improve hemostasis more effectively compared to platelet units stored at room temperature (RT). [9,10] Improved hemostasis with platelets stored at 4C has been extensively reviewed and is based on a significant amount of in vitro data and 2 RCTs.[9-12] One RCT in children demonstrated reduced blood loss and improved platelet aggregation in the cold stored whole blood arm compared to those in the conventional components arm who were transfused with RT stored platelets in a 1:1:1 ratio.[13] Another trial of adults on aspirin showed improved correction in the bleeding time when a cold stored platelet unit was transfused compared to a conventional RT unit.[14] Furthermore, the use of WB will greatly simplify the logistics of the resuscitation by transfusing the contents of one bag instead of up to three bags that all have to be separately procured and transported from the blood bank under different temperature conditions. This latter advantage is especially important in the pre-hospital setting where space in the helicopter or ambulance is at a premium, and often intravenous (IV) access in the patient is limited. The ability to quickly provide a transfusion to traumatically injured patients has been shown to improve outcomes in both military and civilian trials,[15,16] and it is known that mortality is increased by 5% for every minute that initiating a transfusion was delayed in these patients.[16] Since it is not feasible to transport RBCs, plasma and platelet units in the prehospital setting, the most effective method of resuscitating a patient with traumatic hemorrhagic shock in the prehospital setting is with WB. Effective resuscitation in the prehospital phase of treatment is essential because of the 30,000

preventable deaths per year in the US due to traumatic hemorrhage, approximately 25,000 of these deaths occur in the prehospital phase of resuscitation.[5,17]

A major limitation to implementing low titer group O WB at civilian medical centers is the AABB standard regarding its use. The AABB's Standards for Blood Banks and Transfusion Services require that WB units be ABO-identical with the recipient (standard 5.15.1 in the 31st edition of the standards). There is a theoretical concern that a minor incompatible plasma transfusion could lead to hemolysis of the recipient's RBCs. However, a subsequent standard permits the transfusion of minor incompatible plasma so long as the transfusion service has a policy guiding this practice (standard 5.15.4 in the 31st edition of the standards). According to the latter standard, a minor incompatible transfusion of group O platelets or plasma could be administered to a group A recipient, as long as the transfusion service has a policy that permits this practice. Therefore, there is a circularity in the AABB standards: a transfusion service is permitted to transfuse the minor incompatible plasma in platelets and plasma units, but not from WB. Standard 5.15.4 does not provide guidance on the number of units or the total quantity of minor incompatible plasma that can be transfused, any specific donor-recipient ABO pairings that are forbidden, what to do with group O minor incompatible units in particular, whether an antibody titer must be performed on the minor incompatible product before it is transfused, or under which clinical circumstances minor incompatible plasma may be transfused – all of this is left to the discretion of the individual transfusion service's medical director. It therefore remains unclear why the regulation of WB transfusion was specifically excluded from Standard 5.15.4.

The safety of transfusing minor incompatible plasma, mainly through platelet transfusions, is well documented. In 2015, there were nearly 2 million apheresis and whole blood platelet units transfused in the US,[18] and in the United Kingdom there were over 300,000 doses issued to hospitals in 2016.[19] Many of these transfusions would surely have featured a minor incompatibility between donor and

recipient.[20] Yet the number of times that recipients experienced a hemolytic episode from the minor incompatible plasma in the platelet dose remains very small, on the order of a few case reports (reviewed in references 21 and 22). Furthermore, in a study of 16 hematology/oncology patients who received at least one ABO-identical and a minor mismatched platelet transfusion within a 24 hour period,[23] Mair and Benson found that there was no significant difference in the mean change in hemoglobin concentration following the ABO-identical vs. the minor mismatched platelet transfusions. This indicates that hemolysis did not occur following the transfusion of the minor mismatched platelet unit in spite of the fact that most of the minor incompatible platelets were group O; these units potentially have higher titers of anti-A and/or anti-B compared to platelets from the other blood groups and are considered to be the highest risk product in terms of causing hemolysis following a minor incompatible transfusion. None of these minor incompatible platelet transfusions were shown to contain low titers of anti-A and/or –B, and yet significant hemolysis did not occur. Furthermore, traumatically injured patients are often transfused with large quantities of platelet units. In fact, in the recent PROPPR trial the median number of whole blood platelet units transfused in the high ratio group was 12 (effectively a double dose of platelets in adults) within the first 24 hours.[8] A double dose of platelets contains approximately 600 ml of potentially minor-incompatible plasma. Thus, it is commonplace to provide traumatically injured patients with large quantities of potentially incompatible plasma.

The safety of the use of group A plasma in trauma (STAT) study demonstrated that group B and AB trauma recipients who received an average of 4 units of group A plasma during their resuscitation did not have increased early- or in-hospital mortality, or longer hospital lengths of stay compared to group A trauma patients who also received group A plasma.[24] There were also no reported acute hemolytic reactions reported amongst these B and AB recipients. Importantly, the vast majority of the participating hospitals in this study (76%) did not titer the anti-B in the plasma and were thus not

intentionally providing low titer units to their trauma patients, and yet there were no demonstrably worse outcomes amongst the B and AB recipients who received minor incompatible plasma transfusions compared to those who received fully compatible transfusions.

The safety of using cold stored, low titer (<50 anti-A and –B by manual saline tube immediate spin without enhancements) WB in traumatically injured civilian patients has been demonstrated.[25,26] In a study of 27 non-group O and 17 group O recipients, there was no laboratory or clinical evidence of hemolysis in the former group compared to the latter group of recipients, with the exception of a higher median level of total bilirubin amongst the non-group O recipients on the day of receipt of WB.[25] This higher median total bilirubin level was still within the normal range, and the difference in this parameter between the group O and non-group O recipients was no longer apparent on the following day. These observations have been extended to include additional recipients, and recipients of greater numbers of WB units (3 and 4 units), and there continues to be no biochemical or clinical evidence of hemolysis amongst the non-group O recipients (M. Yazer, unpublished observations). Furthermore, low titer (<50, as described above) cold stored group O WB has also been successfully implemented at the Children's Hospital of Pittsburgh. Traumatically injured children older than 3 years and weighing more than 15 kg can receive up to 30 ml/kg of uncrossmatched group O WB. The non-O pediatric recipients did not demonstrate clinical or laboratory evidence of hemolysis compared to the group O pediatric recipients (data to be presented as an oral abstract at the 2017 AABB annual meeting).

It is interesting to note that the 5 civilian trauma centers or emergency medical systems in the US and Norway that are using group O WB have all adopted an anti-A and anti-B titer threshold of between <50 and <200 to define "low titer".[27] This could be a reasonable range for blood centers and transfusion services to consider when creating their local definition of a low titer. Thus, as the evidence from the civilian adult and pediatric experience with WB indicates, these low titer group O WB units have an

enhanced safety margin compared to untitered minor incompatible plasma that is transfused with non ABO compatible platelet units. Furthermore, the fact that only low titer WB units are being issued to civilian trauma patients in the US adds yet another layer of safety and reassurance about the safety of using low titer WB in trauma patients regardless of whether their ABO group is known at the time of the transfusion or not.

The safety of transfusing minor incompatible plasma is well established and indeed this practice is permitted in the AABB standards (5.15.4) for all plasma-containing products except WB. However, the transfusion of WB to a recipient of unknown ABO group is prohibited by standard 5.15.1 thereby delaying the administration of this product to some massively bleeding patients. This prohibition is retarding the implementation of civilian pre- and early in-hospital WB transfusion programs. The AABB/THOR working party has generated a petition that has been signed by 214 experts in the fields of transfusion medicine and resuscitation medicine from 24 countries, demonstrating that there is significant domestic and international interest in using low titer group O WB in traumatically injured patients or in others with life-threatening hemorrhage.

With the growing body of evidence indicating that low titer group O WB is serologically safe for non-O recipients in adults and children, and the increasing support and demand for this product in the US, Standard 5.15.1 should be modified to permit the use of low titer, group O WB in massively bleeding patients regardless of their ABO group. Requiring each individual medical center to submit a variance is an inefficient approach to permitting the use of low titer group O WB. Each transfusion service would also follow Standard 5.15.4 and devise a policy that specifies the definition of low titer, the quantity of group O WB that can be transfused per patient, the nature of massively bleeding patients who would qualify to receive it, and any clinical surveillance of the recipients of this product that may be necessary.

References

1. Crosby WH, Akeroyd JH. Some immunohematologic results of large transfusions of group O blood in recipients of other blood groups; a study of battle casualties in Korea. Blood 1954;**9**: 103-16.
2. Berseus O, Boman K, Nessen SC, Westerberg LA. Risks of hemolysis due to anti-A and anti-B caused by the transfusion of blood or blood components containing ABO-incompatible plasma. Transfusion 2013;**53 Suppl 1**: 114S-23S.
3. Barnes A. Transfusion of universal donor and uncrossmatched blood. Bibl Haematol 1980: 132-42.
4. Spinella PC, Perkins JG, Grathwohl KW, Beekley AC, Holcomb JB. Warm fresh whole blood is independently associated with improved survival for patients with combat-related traumatic injuries. J Trauma 2009;**66**: S69-76.
5. Spinella PC, Cap AP. Whole blood: back to the future. Curr Opin Hematol 2016;**23**: 536-42.
6. Bahr MP, Yazer MH, Triulzi DJ, Collins RA. Whole blood for the acutely haemorrhaging civilian trauma patient: a novel idea or rediscovery? Transfus Med 2016;**26**: 406-14.
7. Davenport RA, Brohi K. Cause of trauma-induced coagulopathy. Curr Opin Anaesthesiol 2016;**29**: 212-9.
8. Holcomb JB, Tilley BC, Baraniuk S, Fox EE, Wade CE, Podbielski JM, del Junco DJ, Brasel KJ, Bulger EM, Callcut RA, Cohen MJ, Cotton BA, Fabian TC, Inaba K, Kerby JD, Muskat P, O'Keeffe T, Rizoli S, Robinson BR, Scalea TM, Schreiber MA, Stein DM, Weinberg JA, Callum JL, Hess JR, Matijevic N, Miller CN, Pittet JF, Hoyt DB, Pearson GD, Leroux B, van Belle G. Transfusion of plasma, platelets, and red blood cells in a 1:1:1 vs a 1:1:2 ratio and mortality in patients with severe trauma: the PROPPR randomized clinical trial. Jama 2015;**313**: 471-82.
9. Reddoch KM, Pidcoke HF, Montgomery RK, Fedyk CG, Aden JK, Ramasubramanian AK, Cap AP. Hemostatic function of apheresis platelets stored at 4 degrees C and 22 degrees C. Shock 2014;**41 Suppl 1**: 54-61.
10. Pidcoke HF, McFaul SJ, Ramasubramanian AK, Parida BK, Mora AG, Fedyk CG, Valdez-Delgado KK, Montgomery RK, Reddoch KM, Rodriguez AC, Aden JK, Jones JA, Bryant RS, Scherer MR, Reddy HL, Goodrich RP, Cap AP. Primary hemostatic capacity of whole blood: a comprehensive analysis of pathogen reduction and refrigeration effects over time. Transfusion 2013;**53 Suppl 1**: 137S-49S.
11. Nair PM, Pidcoke HF, Cap AP, Ramasubramanian AK. Effect of cold storage on shear-induced platelet aggregation and clot strength. J Trauma Acute Care Surg 2014;**77**: S88-93.
12. Nair PM, Pandya SG, Dallo SF, Reddoch KM, Montgomery RK, Pidcoke HF, Cap AP, Ramasubramanian AK. Platelets stored at 4 degrees C contribute to superior clot properties compared to current standard-of-care through fibrin-crosslinking. Br J Haematol 2017;**178**: 119-29.
13. Manno CS, Hedberg KW, Kim HC, Bunin GR, Nicolson S, Jobes D, Schwartz E, Norwood WI. Comparison of the hemostatic effects of fresh whole blood, stored whole blood, and components after open heart surgery in children. Blood 1991;**77**: 930-6.
14. Becker GA, Tuccelli M, Kunicki T, Chalos MK, Aster RH. Studies of platelet concentrates stored at 22 C nad 4 C. Transfusion 1973;**13**: 61-8.
15. Kotwal RS, Howard JT, Orman JA, Tarpey BW, Bailey JA, Champion HR, Mabry RL, Holcomb JB, Gross KR. The Effect of a Golden Hour Policy on the Morbidity and Mortality of Combat Casualties. JAMA Surg 2016;**151**: 15-24.

16. Meyer DE, Vincent LE, Fox EE, O'Keeffe T, Inaba K, Bulger E, Holcomb JB, Cotton BA. Every minute counts: Time to delivery of initial massive transfusion cooler and its impact on mortality. J Trauma Acute Care Surg 2017;**83**: 19-24.
17. Barnes A, Jr. Status of the use of universal donor blood transfusion. CRC Crit Rev Clin Lab Sci 1973;**4**: 147-60.
18. Ellingson KD, Sapiano MRP, Haass KA, Savinkina AA, Baker ML, Chung KW, Henry RA, Berger JJ, Kuehnert MJ, Basavaraju SV. Continued decline in blood collection and transfusion in the United States-2015. Transfusion 2017;**57 Suppl 2**: 1588-98.
19. Bolton-Maggs PBH, Poles D. on behalf of the Serious Hazards of Transfusion (SHOT) Steering Group. 2016 Annual SHOT Report (2017). 2017.
20. Cooling LL, Downs TA, Butch SH, Davenport RD. Anti-A and anti-B titers in pooled group O platelets are comparable to apheresis platelets. Transfusion 2008;**48**: 2106-13.
21. Josephson CD, Castillejo MI, Grima K, Hillyer CD. ABO-mismatched platelet transfusions: strategies to mitigate patient exposure to naturally occurring hemolytic antibodies. Transfus Apher Sci 2010;**42**: 83-8.
22. Lozano M, Cid J. The clinical implications of platelet transfusions associated with ABO or Rh(D) incompatibility. Transfusion medicine reviews 2003;**17**: 57-68.
23. Mair B, Benson K. Evaluation of changes in hemoglobin levels associated with ABO-incompatible plasma in apheresis platelets. Transfusion 1998;**38**: 51-5.
24. Dunbar NM, Yazer MH, Biomedical Excellence for Safer Transfusion C, the SSI. Safety of the use of group A plasma in trauma: the STAT study. Transfusion 2017.
25. Seheult JN, Triulzi DJ, Alarcon LH, Sperry JL, Murdock A, Yazer MH. Measurement of haemolysis markers following transfusion of uncrossmatched, low-titre, group O+ whole blood in civilian trauma patients: initial experience at a level 1 trauma centre. Transfus Med 2017;**27**: 30-5.
26. Yazer MH, Jackson B, Sperry JL, Alarcon L, Triulzi DJ, Murdock AD. Initial safety and feasibility of cold-stored uncrossmatched whole blood transfusion in civilian trauma patients. J Trauma Acute Care Surg 2016;**81**: 21-6.
27. Zielinski MD, Stubbs JR, Berns KS, Glassberg E, Murdock AD, Shinar E, Sunde GA, Williams S, Yazer MH, Zietlow S, Jenkins DH. Prehospital blood transfusion programs: Capabilities and lessons learned. J Trauma Acute Care Surg 2017;**82**: S70-S8.