Implementation of a new blood cooler tracking technology & its effect on Reducing RBC Wastage

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Disclosure

- I have no conflict or other relationships related to the content of this presentation

- I have no relevant financial relationships to disclose

Objectives

- Discuss the implementation of our new blood cooler insert & tracking technology
- Explain how we track our blood coolers using RFID tags
- Discuss the monitoring system we use to track blood coolers
- Review of our data over the 3 year period of implementation
- Present the cost savings

BLOOD MANAGEMENT

ORIGINAL RESEARCH

Implementation of a new blood cooler insert and tracking technology with educational initiatives and its effect on reducing red blood cell wastage

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Outline

- Blood component wastage
- Blood Transfusion therapy cost
- Hybrid transportation strategy
- Educational initiatives and annual competency
- Reduction in annual total RBC wastage
- New Cooler update and mobile blood product storage
- Conclusions

Blood Component wastage

- Quality indicators of blood utilization*
- C-T ratio, RBC wastage, RBC unit expiration
- 12,288,404 red blood cell units in 1639 hospitals
- Reported range for RBC wastage is 0.0%-6.7%
- Low wastage rate were seen in hospital with fewer than 200 beds
- Hospitals without residency or medical student teaching programs

Novis et al. Arch Pathol Lab Med. 2002;126:150–156*

Blood Component wastage

- US Department of Health and Human Services in 2011 –Plasma wastage-1.8% -Metcalf et al. Am J Clin Pahol 2016 Jul;146(1):18-24
- Strategies to reduce RBC wastage- (0.0-7%) Bots et al. Vox Sanguinis (2016) 110, 143–149
- <1% chosen as a quality indicator-Zoric et al. Eur J Anaesthesiol 2013; 30:250–255
- No published data establishing normal threshold

RBC wastage at Wake Forest

- Over a 3 year period wastage averaged 0.64% of 26,403 issued RBC products
- Majority of RBC units wasted due to:

➢ Dispensed but not administered units out of BB for more than 30 minutes

➢ Blood left in the cooler for “too long” (units packed in picnic-style cooler plus ice block

Reasons For RBC wastage

- Exceeding the maximum tolerated temperature:
- Unit left in the transport cooler
- Unit not administered
- Unit not returned to the BB within the required time
- Unit bag inadvertently punctured by the nurse
- Unit lost or discarded and never returned to the BB
- RBC component outdate in the BB

Blood Transfusion Cost

- Simplest way to examine blood costs is cost per unit of RBC transfused
- Cost of blood typically separated into direct and indirect costs (divided into variable and fixed costs)*
- A process flow model usually used to determine costs per step (more step more cost)

Shander et al. Best Practice & Research Clinical Anesthesiology 2007*

Blood Transfusion Cost

- Inpatient transfusion based on diagnosis related group (DRGs)
- Outpatient transfusion to oncology patients may include
- Direct cost such as (blood, supplies, tests, clinical personnel, managerial, facility, capital
- Indirect cost such as (support services, facility and general administration) all per unit
- The cost to have a blood transfusion can range from $1800 to $3000/unit*
- $1400/unit based on European estimate

Shander et al. Best Practice & Research Clinical Anesthesiology 2007*

Hybrid Transportation Strategy

- Novel blood cooler insert that enabled long term compliant storage
- Advanced radiofrequency identification (RFID) tracking
- Real time location services (RTLS) software system
- Computer screen that displays the RTLS system

Hybrid Transportation Strategy

- Analyze 72 months (Jan 2010-December 2015) of RBC issued, transfused, and waste data
- Old transport cooler was an Igloo picnic-style cooler packed with ice block attached to the lid of the cooler
- Validated for 5 hours at 1 to 6^0C

Hybrid Transportation Strategy

- New cooler with insert (Pelican Biothermal, MN)
- Thermal isolation chamber with integrated phase change material designed to maintain a temperature range of 1 to 6^0C for a minimum of 16 hours
- Insert coolant was validated for 10 hours at 1 to 6^0C without the need for replacement

The insert with lid maintains the temperature at 1 to 6^{0}C for 10 hours

Hybrid Transportation Strategy

- Each insert is placed into a Golden Hour blood cooler and ready for use
- Conditioned by freezing for a minimum of 8 hours in a regulated -20^{0}C freezer in the BB
- Insert stored at RT until it reaches 2 to 5^{0}C and then either placed in a new cooler or placed in a regulated BB refrigerator for later use

The outside cooler shell insulates the insert

Arrow showing insert properly placed in the cooler shell with its lid closed. To maintain the required 1 to 6^0C temperature

Hybrid Transportation Strategy

- If a conditioned insert is held for later use, the allowable storage time is 72 hours when stored at 1 to 6^0C before reconditioning
- The insert forms a cube around the blood product inside of the Golden Hour cooler
- Validated for an average load of 1-3 RBC units for more than 10 hours at 1 to 6^0C

Hybrid Transportation Strategy

- The new cooler system extended the time an RBC unit can be outside of the BB for up to 10 hours with a temp range from 1 to 6^0C
- Radiofrequency identification (RFID) tags were used on each blood cooler
- Special software called real-time location services (RTLS; Infinite Leap, Winston-Salem, NC) monitor and tracked the coolers throughout the hospital

Hybrid Transportation Strategy

- RTLS: existing institutional infrastructure investment to monitor and track hospital equipment
- Our intervention was adapted using the RTLS system
- RTLS uses infrared technology, similar to a television remote control

Hybrid Transportation Strategy

- RTLS: identify and track the location of each blood cooler and transmit the cooler and location data to our medical center's network
- Battery-powered RFID tags on the blood coolers communicate with sensors installed in hallways, patient care areas, and storage areas
- Transmitting data to the network

Hybrid Transportation Strategy

- The network communicates the exact location of the coolers and the time left since issued out of the BB on monitors in the BB
- The RTLS monitor track the coolers throughout the institution
- Beginning from “available status” to how many hours left counting down from 10 hours

Hybrid Transportation Strategy

- 180 GH coolers and approximately 200 inserts were purchased
- The cost of each cooler with insert is approximately $275
- The cost of the RFID tags is $38 each
- Rarely do the coolers or the RFID tags need to be replaced
- The cost of the computer screen that displays the RTLS system is approximately $300

Hybrid Transportation Strategy

- The time needed each day by the BB to monitor the screens and or e-mails varies depending on the amount of coolers dispensed from the BB

- BB staff on each shift monitors the e-mails for coolers that are nearing expiration

RTLS Sample Monitor

Name	Type	Status	Location
BB Cooler, 8NT-2	Cooler, Blood Bank 10 hour	1 Red-Blood Cooler In Use 10hrs 15 mins	MC.NT_8.N-814
BB Cooler, 2SA-1	Cooler, Blood Bank 10 hour	1 Red-Blood Cooler In Use 10hrs 15 mins	MC.SCOA_2.Hall-Nurse Station-Pneumatic T...
BB Cooler, 6AIM-2	Cooler, Blood Bank 10 hour	1 Red-Blood Cooler In Use 10hrs 15 mins	MC.RT_6.Hall-R-610
Cooler, 9 West M-2	Cooler, Blood Bank 10 hour	1 Red-Blood Cooler In Use 10hrs 15 mins	MC.ATW_5.Meds Nurse Station Rear
BB Cooler, 8NT-PLT	Cooler, Blood Bank 10 hour	2 Orange-Blood Cooler In Use 10 hrs	MC.NT_8.Hall-Soiled Holding
Blood Cooler CCC 8ICU-M1	Cooler, Blood Bank 10 hour	3 Yellow-Blood Cooler In Use 9hrs ...	MC.CCC_8.ICU Main Station
BB Cooler 33, OR Golden 10 hr	Cooler, Blood Bank 10 hour	4 Blood Cooler In Use 4hrs - 9hrs 45 mins	MC.SurgSvc_1.Inpt OR_POD A_OR 8
BB Cooler 43, OR Golden 10 hr	Cooler, Blood Bank 10 hour	4 Blood Cooler In Use 4hrs - 9hrs 45 mins	MC.SurgSvc_1.InPt Holding_Hall-Svc Coord
BB Cooler 53, OR Golden 10 hr	Cooler, Blood Bank 10 hour	4 Blood Cooler In Use 4hrs - 9hrs 45 mins	MC.CCC_6.Hall-C606-West Main Station 6234
BB Cooler 50, OR Golden 10 hr	Cooler, Blood Bank 10 hour	5 Blood Cooler In Use under 4 hrs	MC.ATE_10.A-1072
Cooler 6C-1	Cooler, Blood Bank 10 hour	5 Blood Cooler In Use under 4 hrs	MC.NT_5.Isolation-5A.Bed 11
BB Cooler 72, OR Golden 10 hr	Cooler, Blood Bank 10 hour	Available	MC.SurgSvc_1.Blood Bank_N. Door
BB Cooler 37, Credo Cube 10 hr	Cooler, Blood Bank 10 hour	Available	MC.SurgSvc_1.Blood Bank_N. Door

Name **Type** **Status** **Location**

Hybrid Transportation Strategy

- Each cooler issued with a slip to track patient location so as to monitor for the 10 hour limit
- E-mail sent from the RTLS alert BB staff to notify end users to bring the coolers when nearing the 10 hour expiration if RBC unit not transfused
- Coolers stays in home base nursing units when empty

Hybrid Transportation Strategy

- Massive transfusion cases are dispensed in the large Credo coolers (10 to 12 units of RBCs and plasma plus a platelet cooler)
- Both are also monitored and tracked when used in the operating rooms
- The coolers are used for transporting plasma as well

Educational initiatives and annual competency

- PowerPoint presentation available to end users
- Required yearly competency education module on cooler maintenance with quiz
- Electronic incident reporting system available that the BB uses to track blood wastage
- Holding providers, nurses, and staff accountable for blood product wastage

Blood Bank –Blood Coolers

Nursing instructions on proper use of BB coolers to ensure safe blood transport, storage and transfusion of blood products

Blood Storage

- Blood product storage is regulated by

U.S. Food and Drug Administration

Protecting and Promoting *Your* Health

- FDA regulations require a tight temperature range
  - Units of blood (RBC)and plasma must be kept between 1-6˚C
  - RBC / Plasma units returned to the BB >6˚C must be discarded
- One patient in a cooler
- Do not use any refrigerator or device other than the regulated BB cooler for storing blood products

Anatomy of the cooler

The RED coolers consist of 2 parts

The outer cooler shell (insulates the insert)

The insert with lid (maintains 1-6˚C)

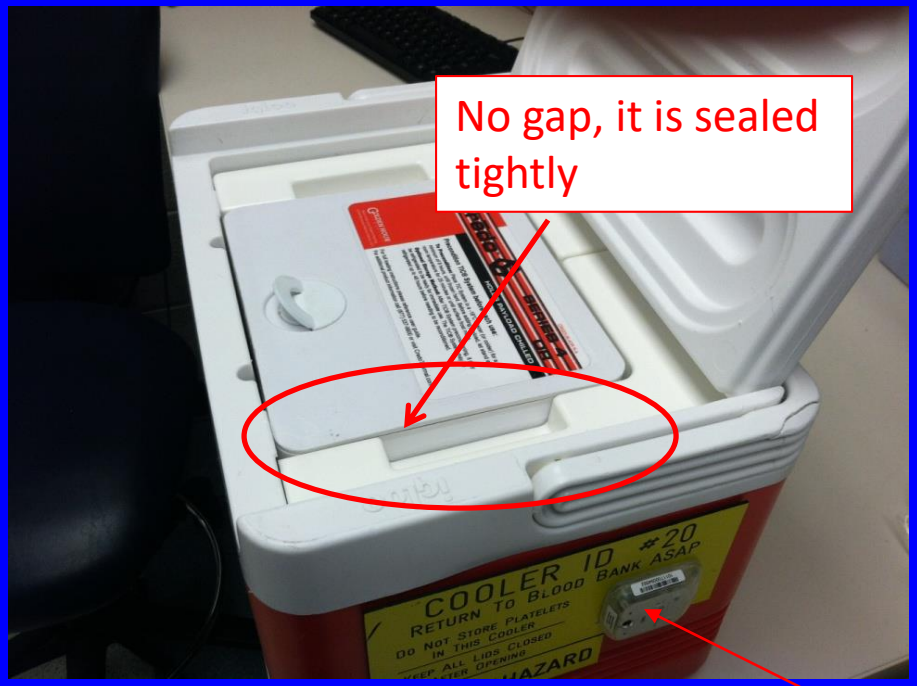
Anatomy of the cooler: The “Insert”

- Inserts are:
  - Conditioned (frozen for minimum of 8 hours) in regulated freezers in the BB
  - Prepared for use by allowing to sit at room temperature (RT) until 2-5°C
  - Placed in regulated BB refrigerator for use
    - Allowable storage time before re-conditioning, 72 hours
  - Inserts CANNOT be conditioned or stored in freezers or refrigerators outside the BB

Cooler Insert

In order to maintain the required 1-6°C, the insert lid must be tightly closed

Properly closed insert lid



Lid ajar. Allows units to warm up above 1-6˚C

RFID tags

Waiting to transfuse

- ***NEVER*** leave the outer shell lid up. Lid must be closed unless accessing units.
- ***NEVER*** take off the insert lid and leave the insert sitting open
- ***NEVER*** take the blood out and lay on the counter or bed
  - Room temperatures can be very warm and the blood will warm up very quickly
- Remove unit **ONLY** when:
  - all vitals and checks are done and

How long is the cooler good for?

- Coolers are validated for **10 hours**
- BB will write the time the cooler needs to be returned on a yellow piece of tape
  - Blood products stored in cooler at the time noted on the tape must be returned to BB immediately
- If blood products are not stored, cooler can be returned to Nursing station

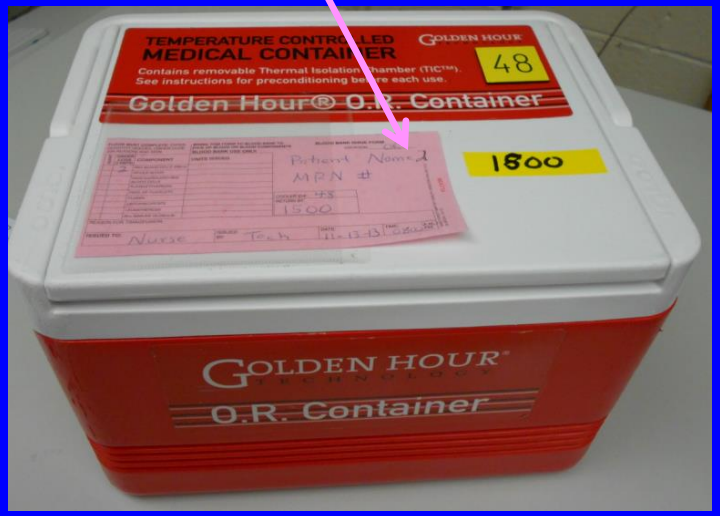
Return cooler by 22:09
on the day it was picked up

Is the cooler empty?

Use the PINK copy of the BB issue form (placed on top of the cooler) as a flag to designate if the cooler is empty

While Blood Products IN Cooler

Leave PINK BB Issue form on lid =



When cooler is EMPTY

Remove BB Issue form from lid and discard

Red cooler- Blood & Plasma

Blue cooler- Platelets & CRYO

Results

- Over a 3-year period before implementation of the revised shipper, the wastage at our institution averaged 0.64% of 26,403 issued RBC products
- A total of 547 wasted RBC units were either “dispensed but not administered”
- Most common reason for RBC product waste in our hospital was “blood left in the cooler for too long”

Results

- Data indicated:
- 93% (509) of the wasted RBC units were blood left in the cooler for too long
- 7% (38) of wasted units were kept out of BB refrigeration for more than 30 minutes

Results

- Other reasons for blood wastage not controlled by the new technology
- **Cooler lid was left open**
- Unused units that outdated in the BB
- Account for a small percentage of blood wastage in our institution

RBC wastage at Wake Forest <u>before</u> implementation of hybrid cooler

Year	# of units issued	# of units transfused	# of units wasted	Wastage rate	Estimated wastage cost
2010	26,592	26,376	211	0.79%	$89, 886
2011	25,985	25,781	189	0.73%	$80,514
2012	26,632	26,221	109	0.64%	$72,278
Total	79,202	78,378	509	2.16%	$242,678
Mean	**26,403**	**26,221**	**170**	**0.64%**	**$72,278**

RBC wastage at Wake Forest <u>after</u> implementation of hybrid cooler

Year	# of units issued	# of units transfused	# of units wasted	Wastage rate	Estimated wastage cost
2013	24,044	23,885	46	0.19%	$19,596
2014	22,772	22,649	32	0.14%	$13,632
2015	21,389	21,302	37	0.18%	$15,762
Total	68,205	67836	115	0.51%	$48,990
Mean	**22,735**	**22,612**	**38**	**0.17%**	**$16,330**

Before	**Mean**	**170**	**0.64%**	**$72,278**
After	**Mean**	**38**	**0.17%**	**$16,330**

Results

- Data showed improved blood utilization and delivery
- Our hybrid transportation strategy reduced mean annual RBC wastage by fourfold from **0.64% to 0.17%**
- Saved RBCs corresponded to a total cost savings during the 3-year period **of $167,844** after implementation

Results

- Blood wastage was reduced using a combination of:

1) RFID cooler tracking (RTLS software)

2) Revised shipper system with doubled coolant time

3) Educational initiatives


WAKE FOREST

Max Q Coolers Inc., OK

3 frozen ice blocks	2 frozen gel packs
24 hours of preconditioning	24 hours pre-C
4-8 units of RBC/plasma	1-3 units RBC/plasma

BioFridge Inc., CA

24 hours of Charging- Hold
24 hours of temp at 1-6^{0}C
20 units of RBC/plasma 1 PLT
20/20/4-RBC/PLT

MTP- massive transfusion cases

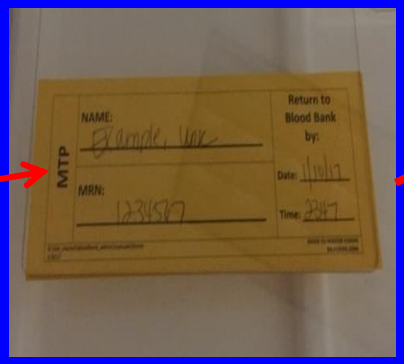
BioFridge for Massive Transfusion Protocol

- Enhance productivity and efficiency in the Blood Bank (BB) with MTP set up and delivery
- Enhance patient safety and blood availability for trauma patients
- Prevent/diminish wastage of blood products and increase cost effectiveness

Please Note:

- **The BioFridge is for use on one patient at a time; therefore, blood dispensed in the BioFridge from the BB cannot be used on another patient, only the patient for which it was dispensed to**

MTP Label with patient info and latest time to return BioFridge to BB will be on the top of the BioFridge



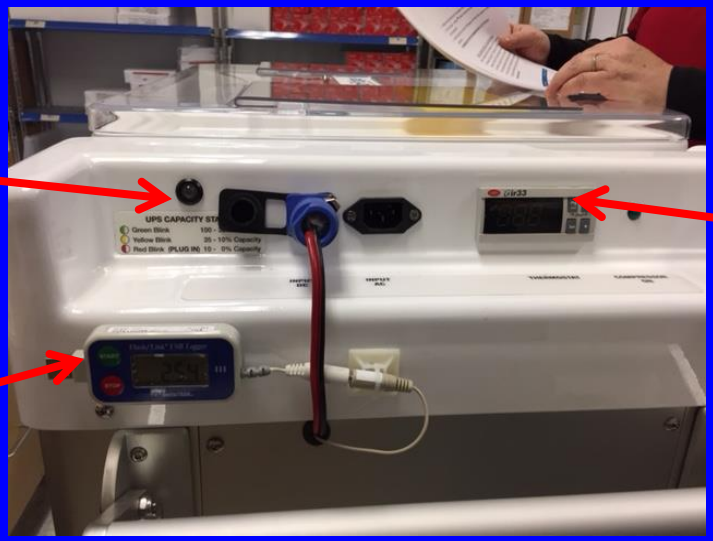
Platelets and cryo ONLY on the clear enclosed top section at room temperature

Red Blood Cells and Plasma only in the two baskets in the refrigerated section

BioFridge for MTP Process

- The secretary, a nurse /CNA or tech will go to the BB with a blood issue slip to pick up the MTP - BioFridge if available. Regulated coolers will be issued if a BioFridge is not available.
- The BB will hand off the stocked BioFridge. It is stocked with blood products for **2 MTPs** (12 RBCs; 12plasma; 2 plateletpheresis) and labeled with any information the BB has (last name, unknown name, room number, etc)
- The secretary/nurse/CNA delivers the BioFridge directly to the patient room
- The BioFridge blood will be transfused as needed. Scanning of all blood products can occur after the MTP is complete.
- When the MTP is completed, the nursing unit must return the BioFridge to the BB as soon as possible. The time it must be returned by will be noted on the yellow MTP tag on top of the BioFridge.
- **Patient transfer to OR**: the BioFridge with blood products will go with the patient and will be handed off to Anesthesia staff once in the OR. The OR is responsible for returning the BioFridge to the BB once the MTP has ended.
- The BioFridge comes stocked with two rounds of MTP. **If a 3rd MTP is required on the patient, the *BB must be called and notified of that request prior to pickup*.** The anesthesia or nursing unit tech/ nurse/secretary/ CNA will return the current BioFridge to BB ***if it is empty*** and it will be restocked with the 3rd MTP. ***If it still has blood products in it, the BioFridge will remain with the patient*** and another BioFridge will be issued if available. If not available then regulated blood coolers will be issued.
- **At no time, should blood products be removed from the BioFridge and placed into another cooler. Blood products must remain in the cooler or BioFridge that they are issued in until they are ready to be spiked for transfusion.**

The refrigerator is on and working when this green light is FLASHING. The BioFridge does not have to be plugged in while out of the BB, but if an outlet is available please plug it in. The temp should be between 1-6 degrees, noted here.



Disregard this setting

Conclusion-1

- Temperature-validated blood cooler inserts
- A state-of-the-art real-time tracking technology
- Educational initiatives and competency
- May help reduce wastage while maintaining the safety of the RBC products

Conclusion-2

- Cost to implement this initiative was small
- If there is an existing institutional infrastructure to monitor and track hospital equipment such as asset tracking and management system
- RFID tags, blood coolers with “inserts” and monitors
- Could result in a highly significant estimated return on investment ($$$)

Acknowledgement & Thanks

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Questions???