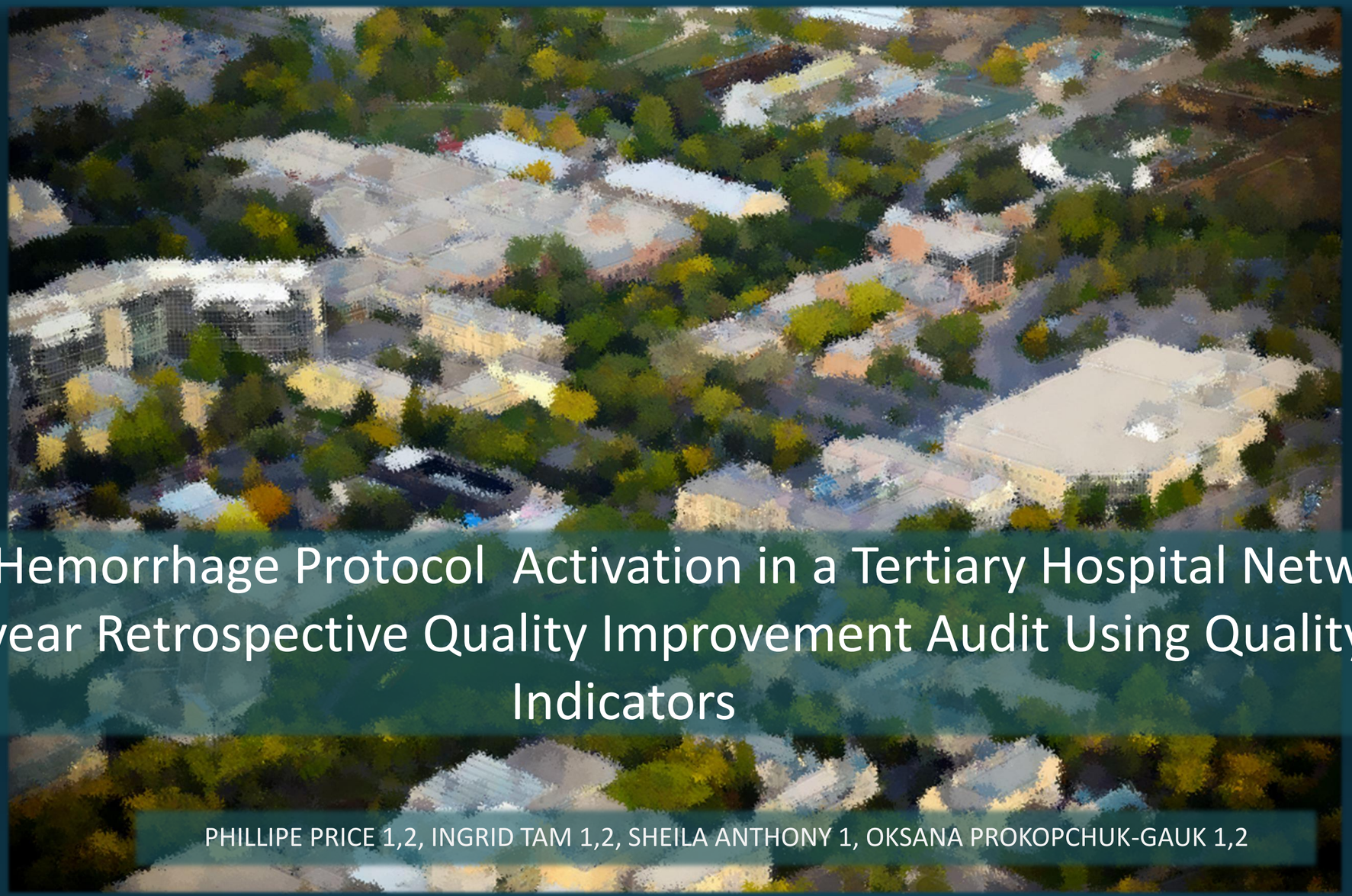


Massive Hemorrhage Protocol Activation in a Tertiary Hospital Network: A 3-year Retrospective Quality Improvement Audit Using Quality Indicators

PHILLIPE PRICE 1,2, INGRID TAM 1,2, SHEILA ANTHONY 1, OKSANA PROKOPCHUK-GAUK 1,2

1 Saskatchewan Health Authority; 2 Department of Pathology and Laboratory Medicine, University of Saskatchewan

Introduction

- Massive bleeding = 10 units of red blood cells (RBC) or more in 24 hours
- Leading preventable cause of death in trauma, childbirth, and surgery [1–3]
- Massive Hemorrhage Protocols (MHP) are a set of instructions
- Streamline delivery of massive amounts of transfusion components (red blood cells, plasma, platelets, and plasma)
- MHP demonstrated to improve operational [4–7] and patient outcomes [8,9]
  - 74% reduction in the odds of mortality [8]
  - independent predictor of survival (86.7% vs. 45.0%, $p < 0.001$) [9]
- In 2019, a multidisciplinary expert committee proposed eight quality-indicators (Q1-Q8, see right) for a successful MHP [4]. These were adopted in the Saskatoon Hospital Network in 2021.

Saskatchewan Health Authority

Saskatoon Adult Massive Hemorrhage Protocol (MHP) "CODE TRANSFUSION" Algorithm

JA-214 February 2025

PHONE NUMBERS:

Call 3-2-1 to activate "CODE TRANSFUSION"

Transfusion Medicine Lab:
JPCH/RUH – 2179;
SPH – 5168; SCH – 8204

Switchboard:
JPCH/RUH – 1000,
SPH – 5000, SCH – 8000

TREATMENT TRIGGERS:

RBC	Hb less than 70-80 g/L
Platelets	less than 75 x 10^9/L; if CNS injury less than 100 x 10^9/L
INR	Greater than 1.8 and bleeding
Fibrinogen	Less than 1.5 g/L and bleeding; If Obstetric, less than 2.0 g/L
Ionized Ca	Less than 1.15 mmol/L, give Ca gluconate 50 mg/kg or Ca chloride 1 g IV (slowly)

***ANTICOAGULANT REVERSAL:**

Dabigatran (Pradaxa)	Idaracizumab (Praxbind) 5 g IV Page Pharmacy STAT
Factor Xa Inhibitors	PCC 25-50 Units/kg (max 3000 Units per dose)
Warfarin	Vitamin K 10 mg IV + PCC 2000 Units IV (if unknown INR)
UFH/LMWH	Protamine 1 mg IV per 100 Units Heparin

All doses presume patient weight 50 kg and over

**For more detail, see QR code:*

PRE-ACTIVATION

IDENTIFY AND MANAGE BLEEDING WITH DEFINITIVE INTERVENTION

BLOODWORK: STAT Group and Screen; CBC, PTT/INR/Fibrinogen, ionized Ca and ABG

Obtain CONSENT for Blood Administration

INITIAL INTERVENTIONS:

- Intravenous Access → 2 large bore IV lines. Minimize crystalloid.
- Continuous Monitoring → Vital Signs, intake/output
- **AGGRESSIVE re-warming (Bair Hugger/fluid warmer); Target Temperature at or above 36°C (Check temp q30 min)**

If not already given, total Tranexamic Acid (TXA) 2 g IV within 3 hours of injury, EXCEPT in GI bleeding

Dosing options: TXA 1 g over 10 min, then 1 hour later give TXA 1 g over 10 min or TXA 2 g over 20 min;
Post-partum hemorrhage only: may give TXA 1g over 30-60 sec

ACTIVATION

MHP ACTIVATION CRITERIA (MRP DISCRETION):

ONGOING MAJOR BLEEDING (BLOOD LOSS 150 ML/MIN OR MORE) AND ANY OF THE FOLLOWING:

- **3 or more units RBC given in 1 hour**
- **Shock Index (HR/SBP) 1.4 or greater**
- **ABC Score 2 or more**

ASSIGN TEAM CONTACT TO: ACTIVATE "CODE TRANSFUSION" – CALL 3-2-1, THEN ask for call transfer to the Transfusion Medicine Lab to provide patient name, sex, age, location, MRP, diagnosis

ADMINISTRATION: PICK UP MHP BOX FROM BLOOD BANK

- Transfuse RBC and Plasma with Rapid Infuser
- Blood co-infusion with NS or PlasmaLyte only
- Blood administration set **REQUIRED** for RBC, plasma, platelets; **NOT** blood products
- Transfuse RBC and plasma through a warmer; **DO NOT** warm platelets

MHP BOX 1
RBC 4 Units
Plasma 4 Units (requires thaw)
If Obstetric MHP:
Fibrinogen Concentrate 4 g

Alternate MHP Box 1 and 2; contents should be customized based on test results

PLATELET 1 Unit issued on MRP request (ex. antiplatelet meds) or if platelet count less than 75 x 10^9/L

MHP BOX 2
RBC 4 Units
Plasma 2 Units
Fibrinogen Concentrate 4 g (if not issued in Box 1)

HEMOSTASIS AND RESOLUTION OF COAGULOPATHY?
Ex. Bleeding source control achieved, hemodynamically stable, transfusion rate slowed

YES

DISCONTINUE MHP:

- **Team Contact to call Transfusion Medicine Lab with all-clear signal and ensure return of any unused blood to the lab ASAP**
- Resume standard blood ordering practices
- **Debrief**

NO

- **REASSESS** patient, achieve definitive surgical or interventional management – **see QR code*
- **REPEAT LABS Q 30-60 MIN** CBC, INR, Fibrinogen; ionized Ca, ABG; VBG, Lytes, Urea, Creatinine, Magnesium

Methodology

Retrospective chart review, 3 urban hospital facilities (RUH, SPH, SCH) between August 2021 – August 2024

- **data from the first year is presented here**

Primary outcomes:

- **Establish a baseline for compliance rate for 8 quality indicators**
- **Develop a tool for ongoing provincial quality assurance**

Secondary outcomes:

- **Compare Saskatoon hospitals to published data from Ontario hospitals**
- **[MHP activated] vs. [Massive transfusion, no MHP activated].**
  - **Latter group defined by 10+ RBCs issued in 24-hours.**
- **Describe significant challenges in data collection for future improvement strategies.**

Aug 2021 - Aug 2022	
Massive Transfusion (10+ RBCs in 24 hrs)	**32**
MHP activated	24
No MHP	8
MHPs activated	**47**
Aug - Dec 2021	13
Jan - Aug 2022	34

QUALITY INDICATORS [10]

Q1.	Proportion of patients receiving tranexamic acid within 1 hour of protocol activation.
Q2.	Proportion of patients in whom red cell transfusion is initiated within 15 min of protocol activation.
Q3.	Proportion of patients with initiation of call-for-transfer within 60 min of protocol activation (for patients requiring transfer for definitive care).
Q4.	Proportion of patients achieving temperature 35°C or more at termination of the protocol.
Q5.	Proportion of patients with hemoglobin levels maintained between 60 and 110 g/L during protocol activation, excluding certain pediatric populations (e.g., neonates) that may require higher hemoglobin values.
Q6.	Proportion of patients transitioned to group-specific red blood cells and plasma within 90 min of arrival/onset of hemorrhage (e.g. transitioned from group O to patient's actual blood group).
Q7.	Proportion of patients with appropriate activation (e.g. ≥ 6 red cell units in first 24 h, > 40 mL/kg per 24 h of RBCs in pediatric patients) or before this level in patients dying due to hemorrhage within 24 h.
Q8.	Proportion of patients without any blood component wastage (including plasma that is thawed and not used within the 5-day limit on another patient).

Results

MHP activated	Quality Indicators							
Study ID	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**
R210906-01	Y	N	N/A	N	N	Y	Y	Y
R210909-01	N	Y	N/A	Y	N	Y	Y	Y
R210909-02	N	Y	N/A	DNC	DNC	N	Y	N
R210909-03	N	DNC	N/A	DNC	DNC	DNC	DNC	N
R210910-01	Y	Y	N/A	N	DNC	N	Y	Y
R210911-01	Y	Y	N/A	DNC	N	Y	Y	Y
R211020-01	Y	N	N/A	Y	N	N	Y	Y
R211021-01	Y	N	N/A	N	N	Y	Y	Y
R211031-01	Y	N	N/A	Y	N	Y	Y	Y
R211112-01	N	Y	N/A	DNC	N	Y	Y	Y
R211126-01	Y	DNC	N/A	N	N	Y	Y	Y
R211130-01	DNC	N	DNC	Y	Y	N	Y	N
R211207-01	Y	N	N/A	DNC	Y	N	Y	Y
R220409-01	N	Y	N/A	Y	Y	Y	Y	N
R220413-01	Y	Y	N/A	Y	Y	N	Y	N
R220416-01	Y	Y	N/A	Y	N	Y	Y	N
R220424-01	Y	Y	N/A	DNC	N	N	Y	N
R220424-02	N	Y	N/A	DNC	Y	N	Y	N
R220424-03	N	N	N/A	DNC	Y	Y	Y	N
R220521-01	N	Y	N/A	DNC	N	N	Y	Y
R220525-01	Y	Y	N/A	DNC	Y	Y	Y	N
R220801-01	Y	DNC	N/A	DNC	DNC	N	Y	N
R220808-01	Y	DNC	N/A	Y	Y	Y	Y	N
R220823-01	DNC	Y	N/A	DNC	N	N	Y	Y
R220825-01	Y	Y	N/A	DNC	Y	Y	Y	N
R220830-01	DNC	Y	N/A	Y	N	Y	Y	Y
R220831-01	DNC	DNC	N/A	DNC	N	Y	Y	Y

Y=Yes, N=No, DNC= Did Not Collect, N/A=Not applicable

Q1. **TXA within 1 h**

Q2. **First Transfusion within 15 min**

Q3. Call for transfer within 60 min of activation

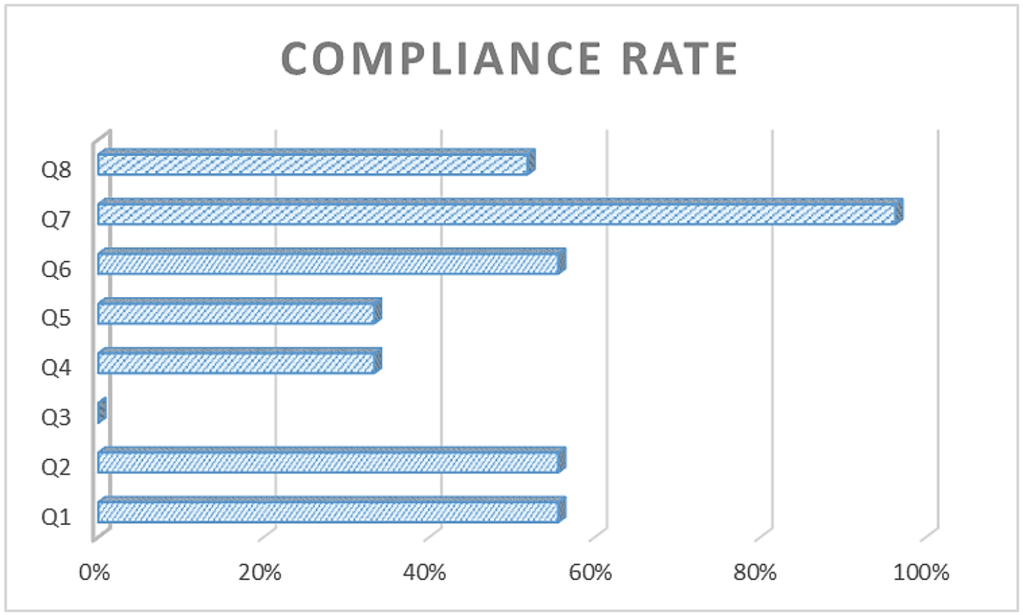
Q4. Temp 35°C or more at termination

Q5. Hb within 60 and 110 g/L

Q6. Group specific RBC and plasma within 90 mins

Q7. Appropriate activation

Q8. No component wastage


COMPLIANCE RATE
Q8
Q7
Q6
Q5
Q4
Q3
Q2
Q1
0%
20%
40%
60%
80%
100%


DATA COLLECTION RATE
Q8
Q7
Q6
Q5
Q4
Q3
Q2
Q1
0%
20%
40%
60%
80%
100%

Discussion

Challenges

- Q2: Time-to-transfusion is tracked on handwritten TAR. Many do not record time of first RBC initiation
- Q3: Difficult to collect. Decision to transfer comes from written notes, and there is no way to determine the interval between decision-to-transfer and call-for-transfer.
- Q4: Temperature is intermittently collected and can be stored in different locations depending which team is overseeing (trauma, ER, surgery/anesthesia, etc.).
- Q5: Many patients with Hb >110 g/L at the end of MHP.
- Q8: Many cases with blood wastage, usually RBC or plasma (see supplementary).
- Overall: Lack of IT makes retrospective data collection very challenging!

Solutions

- Add quality indicators to MHP debrief procedure. Clinical partnership in data collection

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Citations

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