ONTARIO MASSIVE HEMORRHAGE PROTOCOL

A LOOK AT THE LAST 5 YEARS: RESULTS OF PROVINCIAL SURVEY

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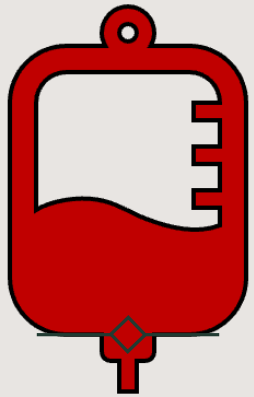
Background



Hemorrhage:

- Leading cause of preventable death in trauma, pregnancy, and non-trauma surgery [1,2]

Massive Hemorrhage Protocols (MHPs)

- Framework of expedited protocols and optimized, standardized systems[3,4.5]
- Damage control principles
- Predefined ratio of blood products

[1]Tien et al, 2007
[2]Kauvar et al, 2006
[3]Chin et al, 2019
[4]Cannon et al, 2017
[5]Petrosoniak et al, 2023

Background

MHPs + Damage Control Resuscitation:

- Improved patient survival[1-4]
- Potentially decreased use of blood products[2, 4]
- Reduced blood wastage[3, 5]
- Decreased length of stay[5]
- Decreased ICU length of stay[5]

MHPs alone:

- Reduced post-resuscitation complications[6]
- Expedite access to transfusions + surgical management[6,9]
- Decreased variability in treatment[6]
- Improved interdisciplinary communication[7]
- Facilitates quality improvement processes[8]
- Compliance with MHPs improves patient outcomes[10]

[1]Cotton et al, 2009
[2]Cotton et al, 2011
[3]Duchesne et al, 2010
[4]Riskin et al, 2009
[5]Khan et al, 2013
[6]Mothukuri et al, 2015
[7]Milligan et al, 2009
[8] Cotton et al, 2009
[9]Callum et al, 2019
[10]Bawazeer et al, 2015

Background

In a 2016 U.S. AAST member survey, 98.4% of responding hospitals had an MHP[1]

- Improved from 88% in 2008
- Mostly Level 1 and 2 trauma centres

Canadian National Standards Council recommends all hospitals that transfuse blood should have a protocol in place for urgent transfusions[3]

[1]Etchill et al, 2017
[3]Dzik et al, 2022

2018 Survey

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Massive hemorrhage protocol survey: Marked variability and absent in one-third of hospitals in Ontario, Canada

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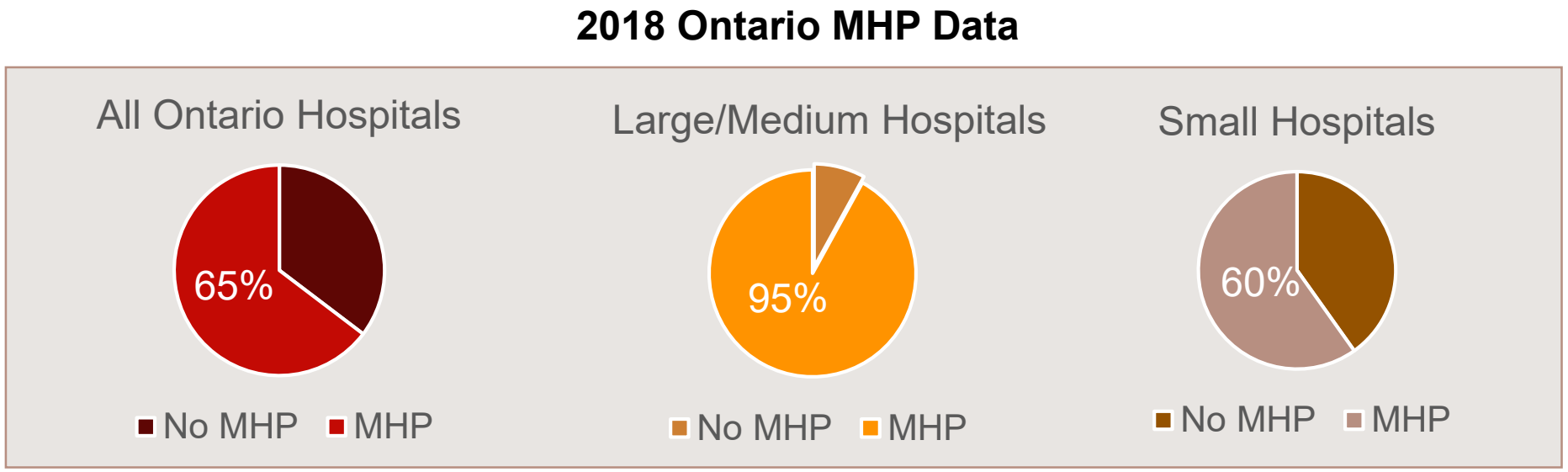
[2]Chin et al, 2019

2018 Survey

In Ontario, Canada, in 2018, only 65% of Ontario hospitals had an MHP[1]



[1]Chin et al, 2019

2018 Survey

Significant variability between Ontario MHPs:

- Activation criteria present in 85% of MHPs
- Lab testing variability (37% drew bloodwork at discretion of physician only)
- Temperature monitoring (65% of protocols)
- Blood pack components (61% issued blood in pre-defined packs)
- Only 32% tracked quality metrics

Chin et al, 2019

Ontario MHP

Provincial Massive Hemorrhage Toolkit

Steering committee:

- Canadian Blood services, ORBCoN, transfusion medicine specialists, trauma physicians

Consensus MHP Provincial Toolkit

- Modified Delphi Technique

156-page toolkit launched April 2021

- www.transfusionontario.org

Just the facts: Massive Hemorrhage Protocol

a **7Ts of massive hemorrhage protocol.**

1. **Trigger massive transfusion protocol**
   Use a combination of clinical judgement, decision tools and response to treatment to activate an MHP.
2. **Team preparation**
   Early notification and preparation of the extended interdisciplinary team: ED team, core lab, blood bank, hematology, surgeons and porters.
3. **Tranexamic acid**
   Administer IV 2g TXA <3hr from injury (preferably <1hr).
4. **Test hourly**
   Standardized laboratory testing done at baseline and hourly until protocol termination. CBC, group & screen, INR/aPTT, fibrinogen, ABG/VBG, iCa, lactate and electrolytes.
5. **Transfuse to target**
   Transfuse using a 2:1 RBC:plasma ratio. Target SBP >80-90mmHg or cerebral perfusion. Switch to lab guided transfusion when available.
6. **Temperature management**
   Measure temperature within 15min of patient arrival or MHP activation. Target temperature >35^{O}C.
7. **Terminate the protocol**
   Terminate protocol when hemostasis is achieved, hemodynamics and laboratory profile improves, or vasopressor requirements cease.

By Dr. Andrew Petrosoniak, Dr. Winny Li and Dr. Christopher Hicks

b

Objective MHP triggers

Critical Administration Threshold	Shock Index	ABC Score	RABT Score
≥3 RBC units	HR/SBP >1	≥2 • Penetrating injury • SBP < 90mmHg • HR > 120 bpm • ✚ FAST	≥2 • Penetrating injury • Shock index >1 • ✚ FAST • ✚ pelvic fracture

Figure 1c.

Standard approach to blood box configuration

Cooler 1. 4U (units) RBCs

Cooler 2. 4U RBCs, 4U plasma (4U RBC, 2000 IU PCCs, 4g fibrinogen)

Cooler 3. 4U RBCs, 2U plasma, 4g fibrinogen (4U RBC, 2000 IU PCCs, 4g fibrinogen)

Modifications for resource constrained institutions

***Platelets** should be transfused when platelets <50 x 10^{9}/L.

Petrosoniak et al, 2023

Follow-Up Survey: Methods

82 question web-based survey

- Short answer and multiple choice
- Divided into nine categories:
  - Demographics, activation criteria, communication, bloodwork, test availability, temperature management, transport containers, transfusion medicine support, and quality metrics tracked

Sent to 159 hospitals

- 158 in Ontario, 1 in Nunavut
- Completion by May 26, 2023
- Follow up by phone if not received

Descriptive Statistics + Chi Squared Analysis ($p<0.05$)

Results

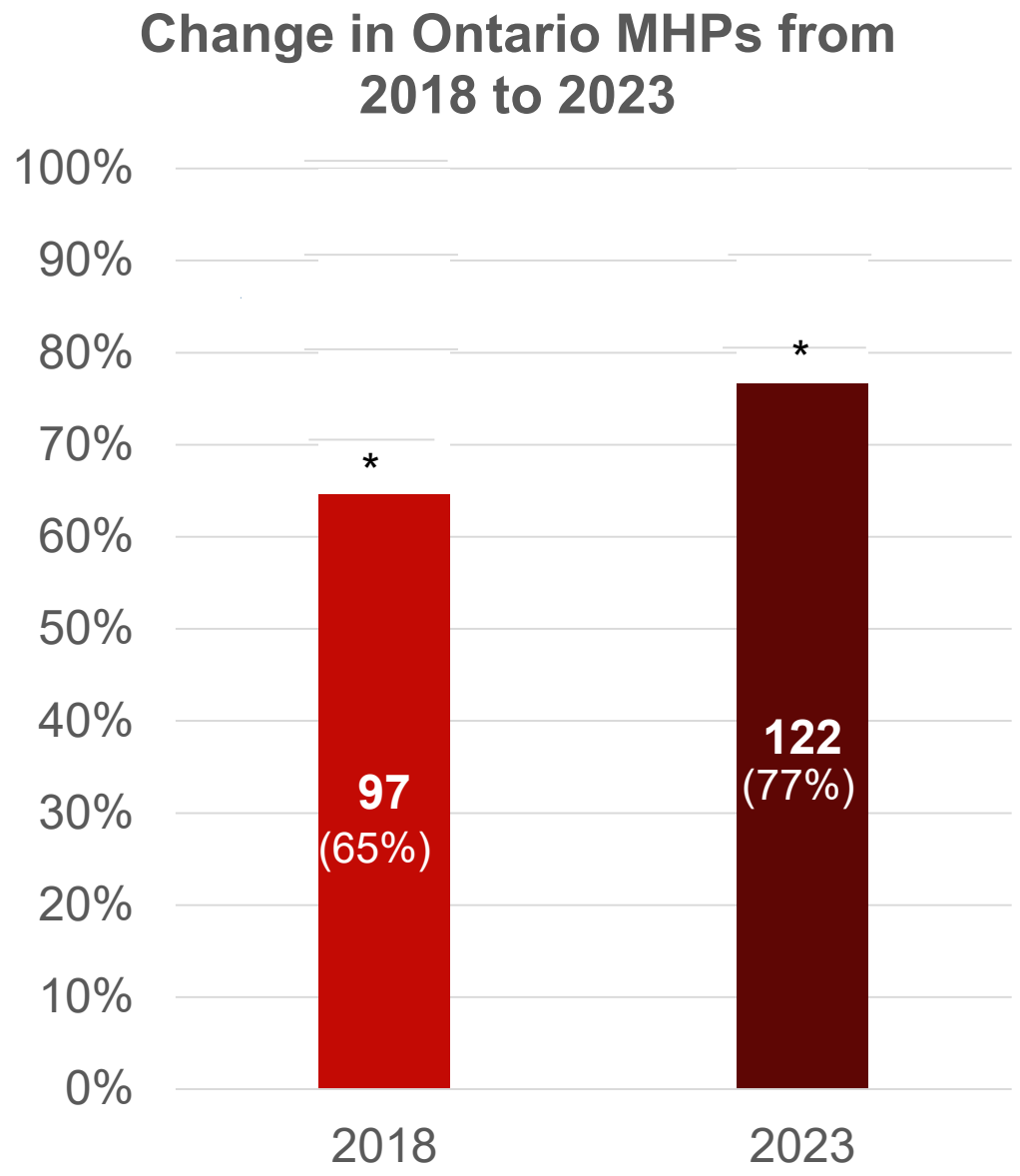
Ontario MHPs in 2018 = 97

- 65% of hospitals

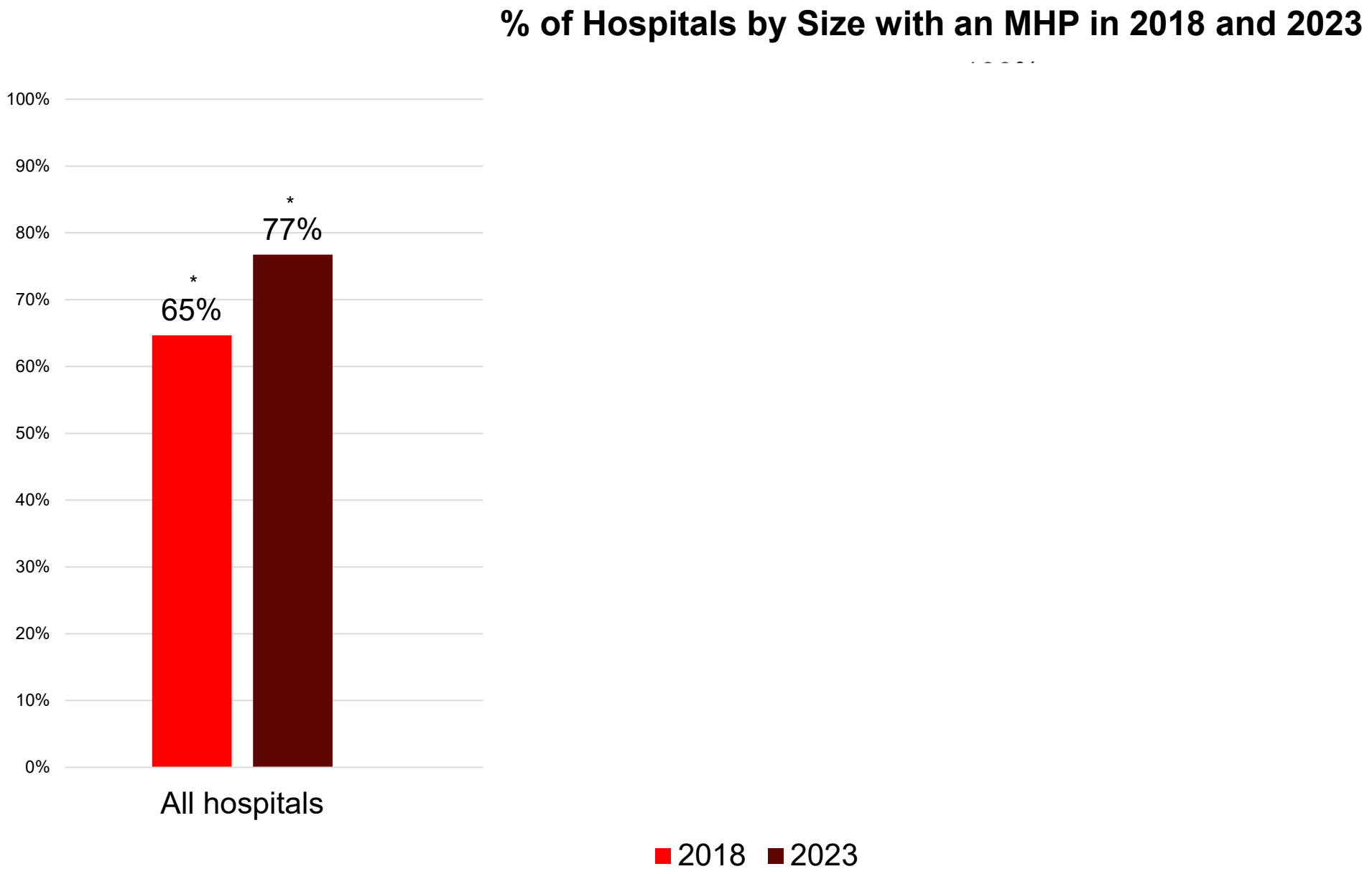
Ontario MHPs in 2023 = 122

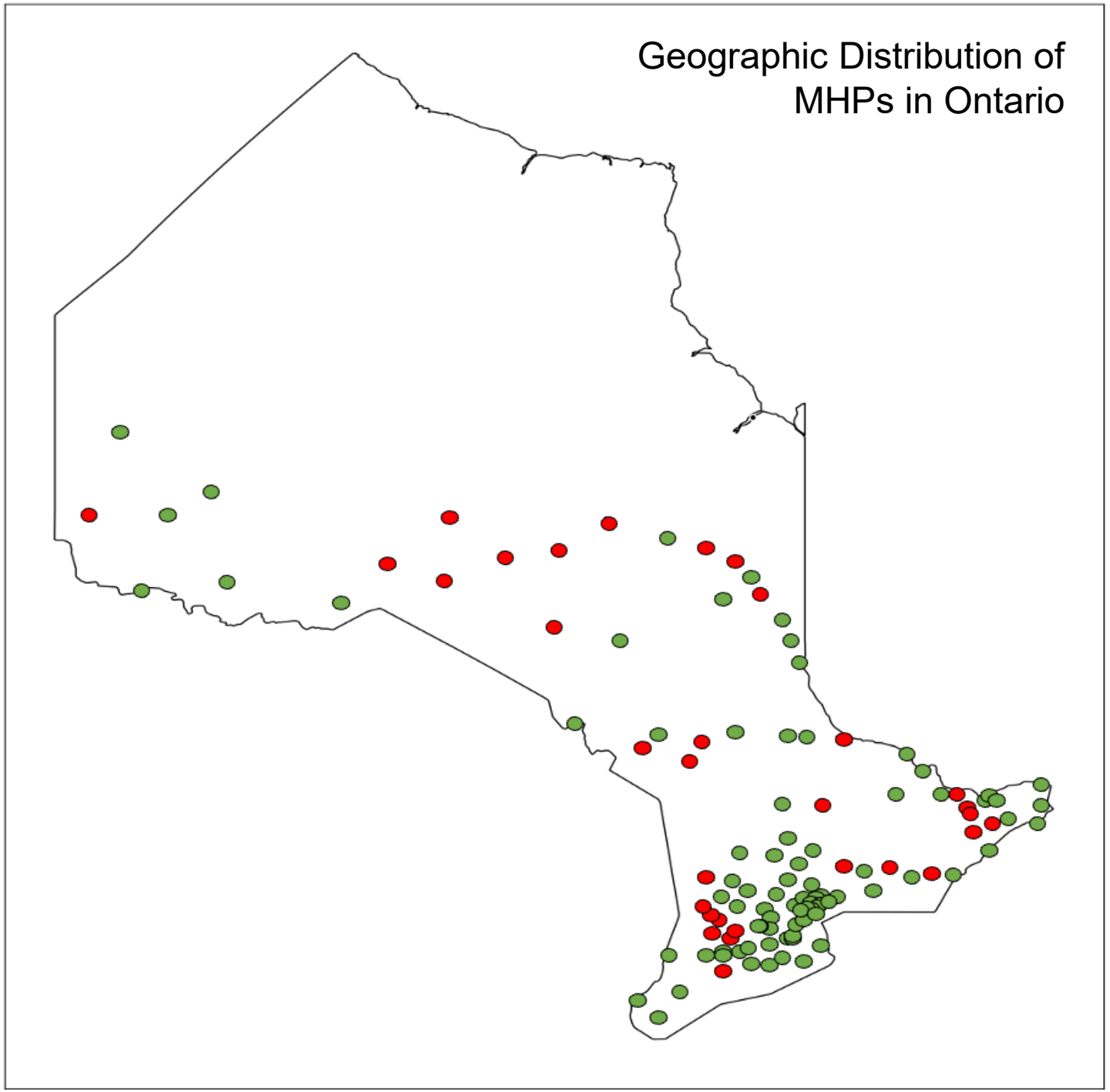
77% of hospitals

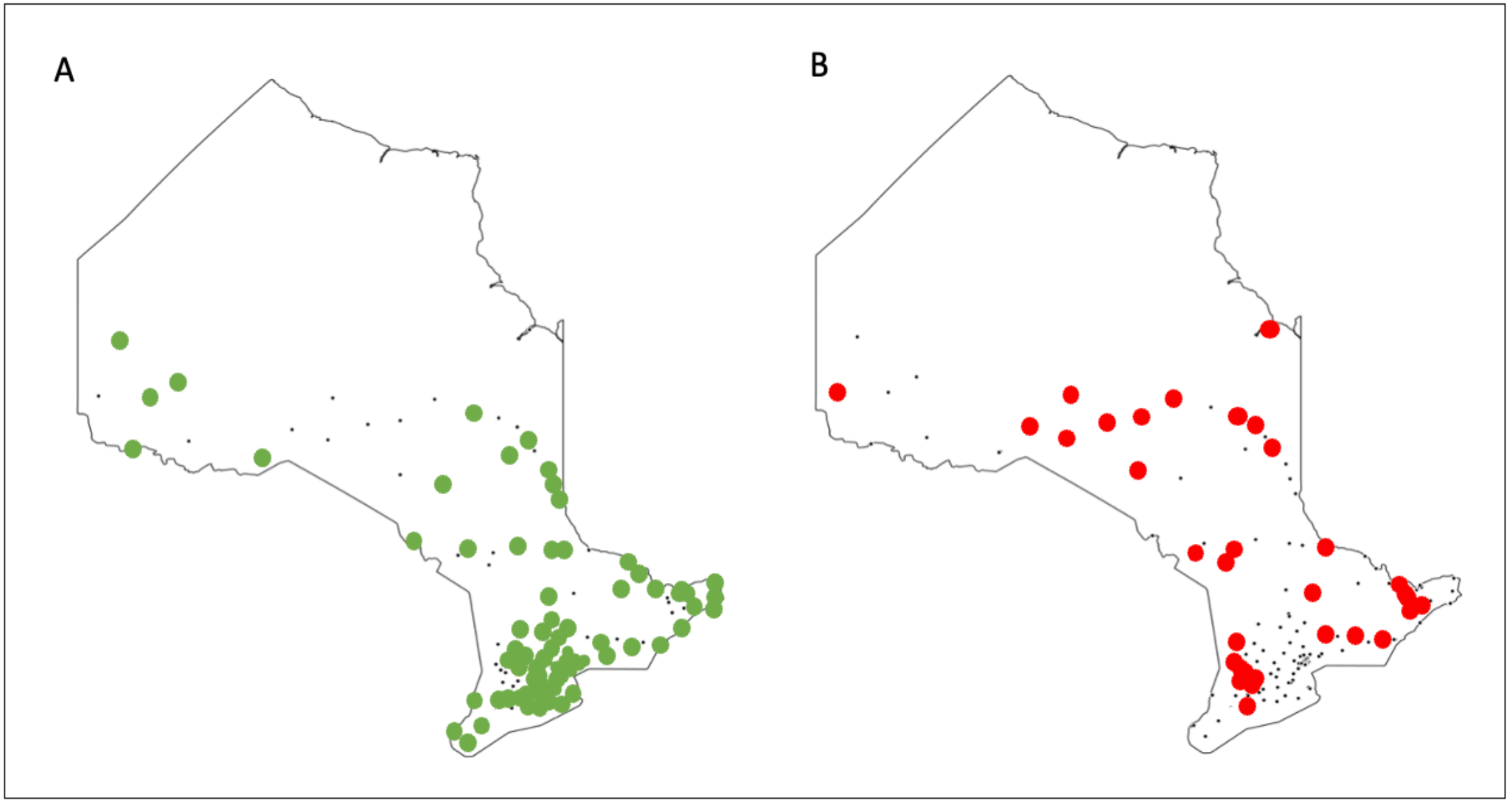
p=0.02
Net increase of 25 hospitals with MHPs
(Note that 9 new hospitals included in new study)



Results

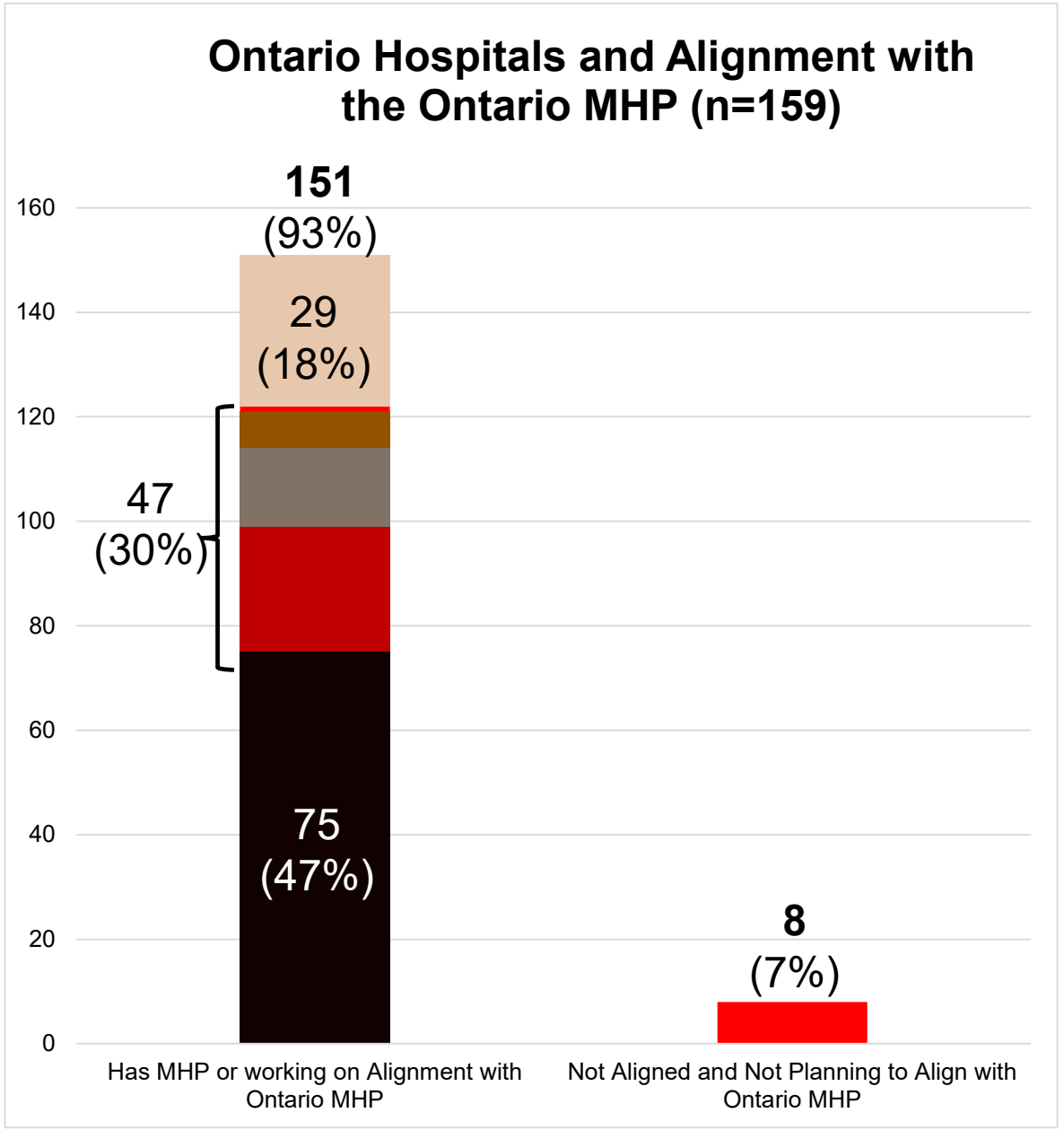

% of Hospitals by Size with an MHP in 2018 and 2023
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
*
65%
*
77%
All hospitals
2018
2023


Geographic Distribution of
MHPs in Ontario
Have MHP
Do Not Have MHP



Ontario hospitals with MHPs (A) and hospitals without MHPs (B)

Results


Ontario Hospitals and Alignment with the Ontario MHP (n=159)
151
(93%)
29
(18%)
47
(30%)
75
(47%)
8
(7%)
160
140
120
100
80
60
40
20
0
Has MHP or working on Alignment with Ontario MHP
Not Aligned and Not Planning to Align with Ontario MHP

Other Results

+ **Massive Transfusion Protocols (MTPs):**
  - Defined as a set number of blood products in a 24-hour period
    - (often > 10 units of blood product in a 24-hour period)

In 2018:
68% were called Massive Transfusion Protocols

Massive Hemorrhage Protocols (MHPs):
- Damage control principles
- Predefined ratio of blood products
- Framework of expedited protocols and optimized, standardized systems

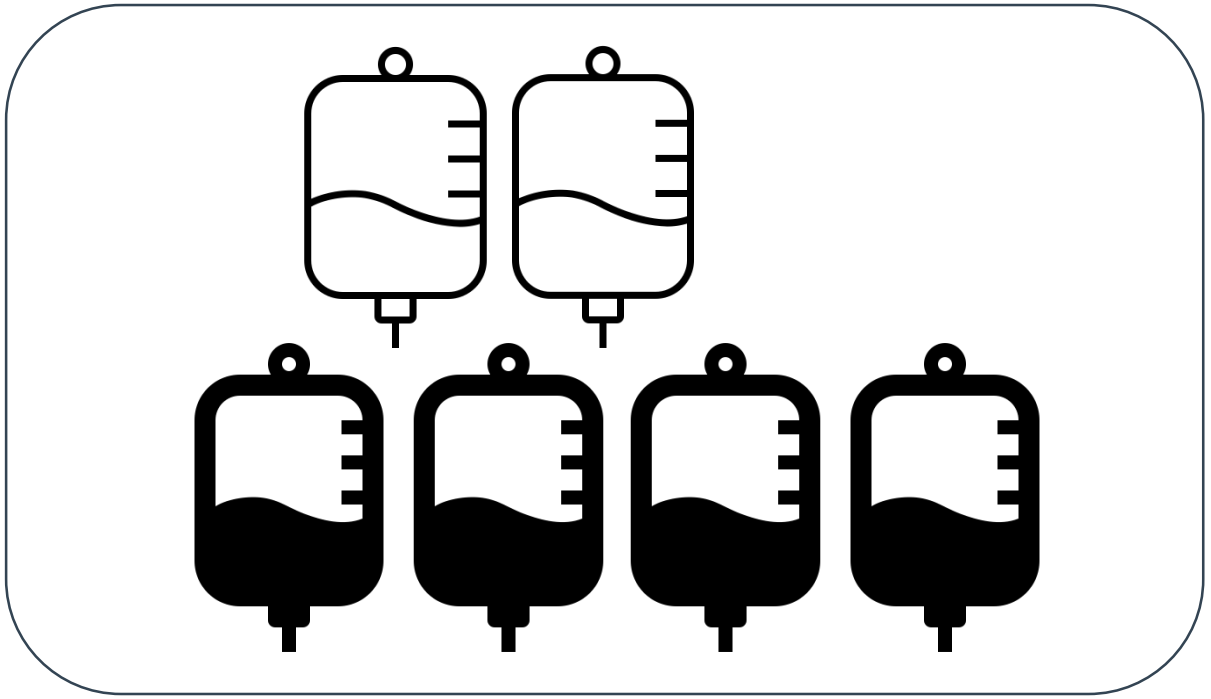
In 2023:
11% were called Massive Transfusion Protocols

Ontario MHP Toolkit
Chin et al, 2019
Cannon et al, 2017

Other Results: Activation and Termination Criteria

- **No significant difference in % of MHPs with activation criteria**
  - Significant increase in sites using hemodynamic parameters for activation criteria
  - Only 7% still using ”physician discretion” as their only criteria
  - Significant increase in sites with overhead page for activation (70%)
  - Majority of overhead page called “Code Transfusion”
- **Termination criteria - Not assessed in 2018**
  - 61% now have termination criteria
  - 65% have provisions for transfer out patients

Other Results: Predefined packs



2018 – 59 sites used pre-defined packs (61%)*
2023 – 100 sites used pre-defined packs (82%)*

Other Results: Pediatrics

- 101 Hospitals with MHPs (83%) provided care for pediatric patients
- Only 56 hospitals included pediatric patients in their MHP (55% of hospitals that provide care for children)
  - No comparison data from 2018
  - Ontario MHP does include provisions for pediatric patients

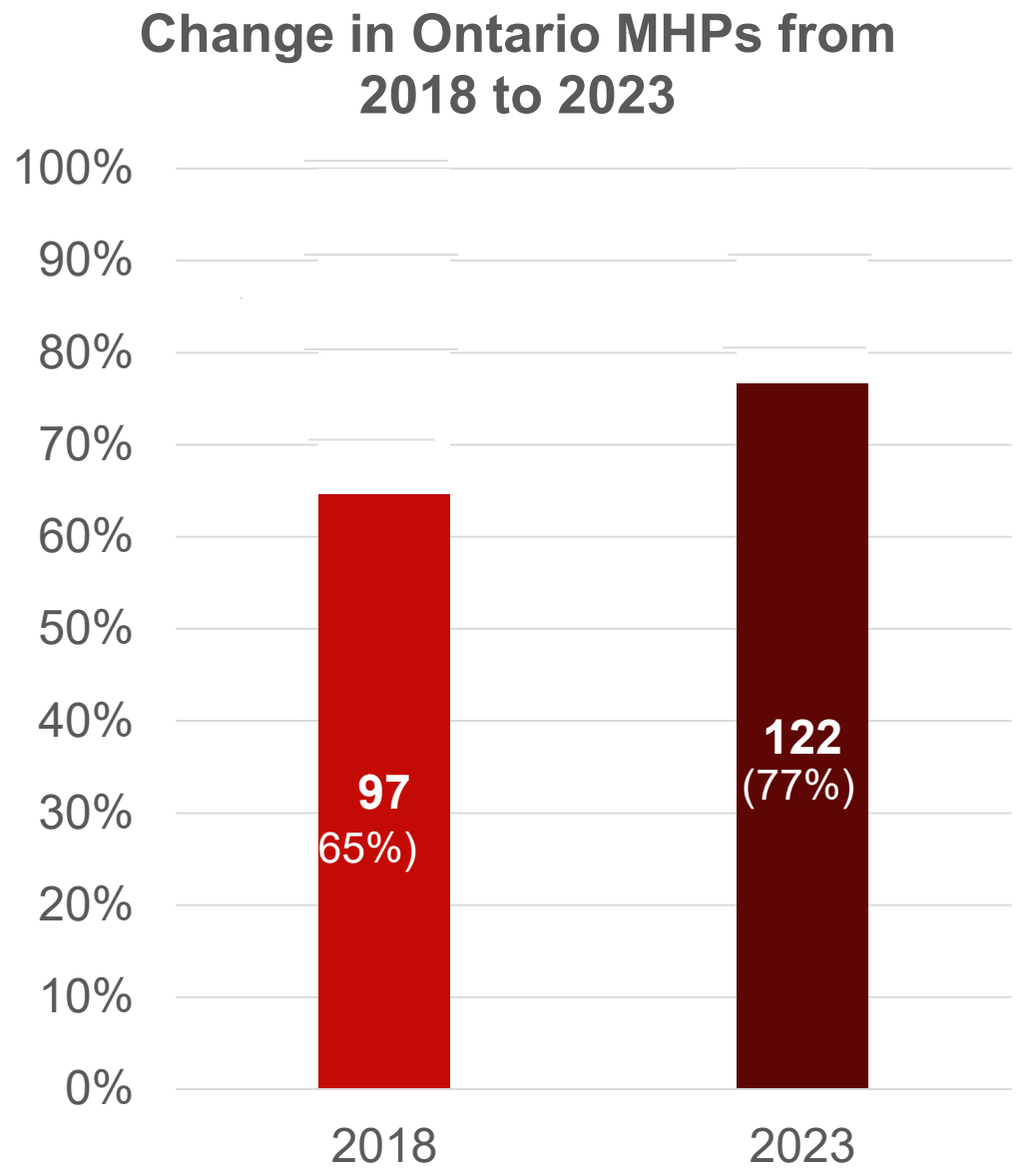
Other Results: Consent and Quality Control

- **Consent**
  - MHP with provision for patient/SDM notification of activation and potential adverse effects: 46 sites (37%)
- **Quality Control**
  - Multidisciplinary debriefs have decreased from 66 sites (68%) to 51 sites (43%)
  - Quality metrics tracked has increased from 30 sites (31%) to 54 sites (45%)

Discussion

Overall:

- Significant improvement to number of MHPs in Ontario (77% of hospitals)
- Even more promising: 93% of sites working on implementing an MHP



Discussion

- **Study Limitations**
  - Self reported data
  - Compliance to existing protocols unknown

- **Areas for improvement for sites with an MHP:**
  - Reduce variability in compliance and standardization
  - Pediatric provisions for sites that see pediatrics
  - Quality metrics

Discussion

Barriers to Implementation:

- Rural sites – low volume of transfusion
- Lack of support, funding, and dedicated time outside of clinical duties
- COVID-related delays in implementation

Future Directions:

- Continue to facilitate implementation of provincial MHP and address barriers
- *Qualitative analysis of barriers to implementation*

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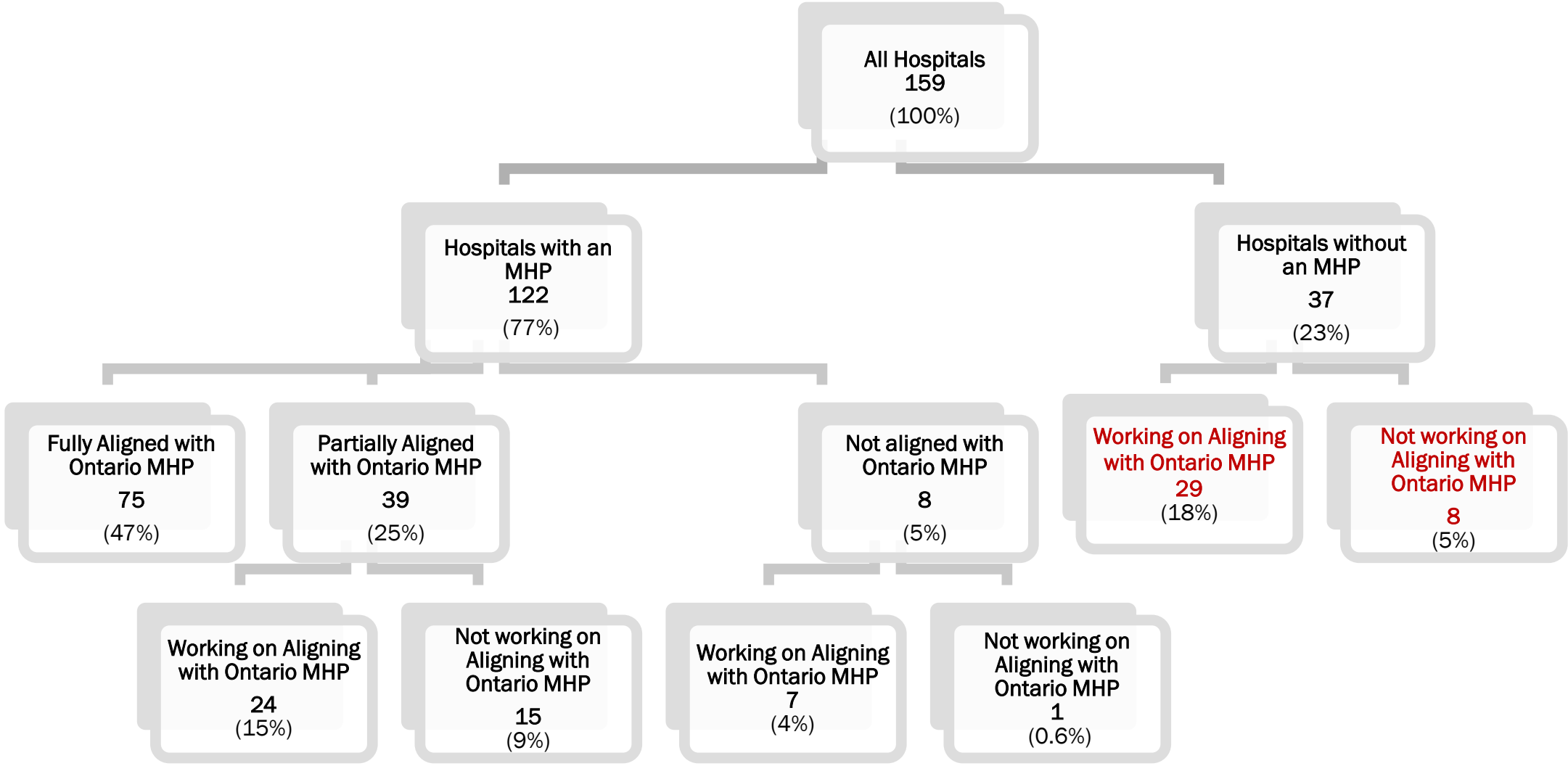
All Hospitals
159
(100%)
Hospitals with an MHP
122
(77%)
Hospitals without an MHP
37
(23%)
Fully Aligned with Ontario MHP
75
(47%)
Partially Aligned with Ontario MHP
39
(25%)
Not aligned with Ontario MHP
8
(5%)
Working on Aligning with Ontario MHP
29
(18%)
Not working on Aligning with Ontario MHP
8
(5%)
Working on Aligning with Ontario MHP
24
(15%)
Not working on Aligning with Ontario MHP
15
(9%)
Working on Aligning with Ontario MHP
7
(4%)
Not working on Aligning with Ontario MHP
1
(0.6%)

References

1. Spinella PC. Zero preventable deaths after traumatic injury: An achievable goal. *Journal of Trauma and Acute Care Surgery* 2017;82(6S)
2. Kauvar DS LR, Wade CE Impact of Hemorrhage on Trauma Outcome: An Overview of Epidemiology, Clinical Presentations, and Therapeutic Considerations. *The Journal of Trauma: Injury, Infection, and Critical Care* 2006;60(6):S3-S11. doi: doi: 10.1097/01.ta.0000199961.02677.19
3. Tien HC, Spencer F, Tremblay LN, et al. Preventable Deaths From Hemorrhage at a Level I Canadian Trauma Center. *Journal of Trauma and Acute Care Surgery* 2007;62(1)
4. Creanga AA, Syverson C, Seed K, et al. Pregnancy-Related Mortality in the United States, 2011–2013. *Obstetrics and gynecology (New York 1953)* 2017;130(2):366-73. doi: 10.1097/AOG.0000000000002114
5. Farooq N, Galiatsatos P, Aulakh JK, et al. Massive transfusion practice in non-trauma related hemorrhagic shock. *Journal of Critical Care* 2018;43:65-69. doi: https://doi.org/10.1016/j.jcrc.2017.08.033
6. Hess JR, Holcomb JB, Hoyt DB. Damage control resuscitation: the need for specific blood products to treat the coagulopathy of trauma. *Transfusion* 2006;46(5):685-86. doi: https://doi.org/10.1111/j.1537-2995.2006.00816.x
7. Holcomb JB, Tilley BC, Baraniuk S, et al. 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 : the journal of the American Medical Association* 2015;313(5):471-82. doi: 10.1001/jama.2015.12
8. Spinella PC, Holcomb JB. Resuscitation and transfusion principles for traumatic hemorrhagic shock. *Blood Reviews* 2009;23(6):231-40. doi: https://doi.org/10.1016/j.blre.2009.07.003
9. Trudeau JD DP, Shih AW. . Clinical Guide to Transfusion: Canadian Blood Services 2021.
10. Cannon JW, Khan MA, Raja AS, et al. Damage control resuscitation in patients with severe traumatic hemorrhage: A practice management guideline from the Eastern Association for the Surgery of Trauma. *Journal of Trauma and Acute Care Surgery* 2017;82(3):605-17. doi: 10.1097/ta.0000000000001333
11. Callum JL, Yeh CH, Petrosoniak A, et al. A regional massive hemorrhage protocol developed through a modified Delphi technique. *CMAJ Open* 2019;7(3):E546-E61. doi: 10.9778/cmajo.20190042
12. Chin V, Cope S, Yeh CH, et al. Massive hemorrhage protocol survey: Marked variability and absent in one-third of hospitals in Ontario, Canada. *Injury* 2019;50(1):46-53. doi: 10.1016/j.injury.2018.11.026
13. Cryer HG NA, Bulger EM, Calland JF, Cohen JM, Cotton BA, Davis ML, Hemmila MR, Hess JR, Jawa R, Kozar R, Minei J, Pavenski K, Schreiber M, Spinella PC, Ingraham AM, Moore HB. ACS TQIP Massive transfusion in trauma guidelines: American College of Surgeons Trauma Quality Improvement Program 2014.
14. Callum JL KP, et al. Provincial Massive Hemorrhage Toolkit. Ontario, Canada: Ontario Regional Blood Coordinating Network (ORBCoN), 2021.
15. Cotton BA, Au BK, Nunez TC, et al. Predefined Massive Transfusion Protocols are Associated With a Reduction in Organ Failure and Postinjury Complications. *Journal of Trauma and Acute Care Surgery* 2009;66(1)
16. Cotton BA, Reddy N, Hatch QM, et al. Damage Control Resuscitation Is Associated With a Reduction in Resuscitation Volumes and Improvement in Survival in 390 Damage Control Laparotomy Patients. *Annals of Surgery* 2011;254(4)
17. Duchesne JC, Kimonis K, Marr AB, et al. Damage Control Resuscitation in Combination With Damage Control Laparotomy: A Survival Advantage. *Journal of Trauma and Acute Care Surgery* 2010;69(1)
18. Riskin DJ, Tsai TC, Riskin L, et al. Massive transfusion protocols: the role of aggressive resuscitation versus product ratio in mortality reduction. *J Am Coll Surg* 2009;209(2):198-205. doi: 10.1016/j.jamcollsurg.2009.04.016 [published Online First: 2009/07/28]
19. Khan S, Allard S, Weaver A, et al. A major haemorrhage protocol improves the delivery of blood component therapy and reduces waste in trauma massive transfusion. *Injury* 2013;44(5):587-92. doi: 10.1016/j.injury.2012.09.029
20. Mothukuri R, Battle C, Guy K, et al. The implementation of massive haemorrhage protocol (MHP) for the management of major trauma: a ten year, single centre study of patient outcomes. *Emergency medicine journal : EMJ* 2015;32(12):991-91. doi: 10.1136/emermed-2015-205372.32
21. Milligan C, Higginson I, Smith JE. Emergency department staff knowledge of massive transfusion for trauma: the need for an evidence based protocol. *Emergency medicine journal : EMJ* 2011;28(10):870-72. doi: 10.1136/emj.2009.088138
22. Cotton BA, Dossett LA, Au BK, et al. Room for (Performance) Improvement: Provider-Related Factors Associated With Poor Outcomes in Massive Transfusion. *The journal of trauma* 2009;67(5):1004-12. doi: 10.1097/TA.0b013e3181bcb2a8
22. Treml A GJ, Dutton R, Scavone B. Massive Transfusion Protocols: A Survey of Academic Medical Centers in the United States. *Anesthesia & Analgesia* 2017;124(1):277-81. doi: doi: 10.1213/ANE.0000000000001610
23. Thomasson RR, Yazer MH, Gorham JD, et al. International assessment of massive transfusion protocol contents and indications for activation. *Transfusion* 2019;59(5):1637-43. doi: https://doi.org/10.1111/trf.15149
24. Hoyt DB, Dutton RP, Hauser CJ, et al. Management of coagulopathy in the patients with multiple injuries: results from an international survey of clinical practice. *The journal of trauma* 2008;65(4):755-64. doi: 10.1097/TA.0b013e318185fa9f
25. Etchill E, Sperry J, Zuckerbraun B, et al. The confusion continues: results from an American Association for the Surgery of Trauma survey on massive transfusion practices among United States trauma centers: Survey of massive transfusion practices. *Transfusion (Philadelphia, Pa)* 2016;56(10):2478-86. doi: 10.1111/trf.13755
27. Dzik WH, Blajchman MA, Fergusson D, et al. Clinical review: Canadian National Advisory Committee on Blood and Blood Products - Massive Transfusion Consensus Conference 2011: Report of the panel. *Critical care (London, England)* 2011;15(6):242-42. doi: 10.1186/cc10498
27. Bawazeer M, Ahmed N, Izadi H, et al. Compliance with a massive transfusion protocol (MTP) impacts patient outcome. *Injury* 2015;46(1):21-28. doi: 10.1016/j.injury.2014.09.020
28. Petrosoniak A, Pavenski K, da Luz LT, et al. Massive Hemorrhage Protocol: A Practical Approach to the Bleeding Trauma Patient. *Emerg Med Clin North Am* 2023;41(1):51-69. doi: 10.1016/j.emc.2022.09.010 [published Online First: 2022/11/25]
29. Spahn, DR, Bouillon B, Cerny V, et al. The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition. *Crit Care* **23,** 98(2019): https://doi.org/10.1186/s13054019-2347-3