

Preventing and Managing PPH at Caesarean Section: algorithms, techniques, and the importance of non-technical skills

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Conflicts of interest to declare

- Doris Mbithi - none
- John Varallo - none

Outline

- Epidemiology
- Detection and diagnosis
- Management
 - Prevention at Caesarean Section (CS)
 - Treatment during and after CS
- Importance of non-technical skills
- Key Takeaways

Epidemiology: Postpartum Haemorrhage

- Definition: 500mls, 750mls, **1000mls**
- Severe PPH: 1500mls; Massive PPH: 2500mls
- > 1000mls
 - Elective CS: 5%
 - Emergency CS: 7%
- >1500mls
 - Emergency CS: 3%

1. Carroli G, Cuesta C, Abalos E, Gulmezoglu AM. Epidemiology of postpartum haemorrhage: a systematic review. *Best Pract Res Clin Obstet Gynaecol.* 2008;22(6):999–1012

2. Al-Zirqi I, Vangen S, Forsén L, Stray-Pedersen B. Effects of onset of labor and mode of delivery on severe postpartum hemorrhage. *Am J Obstet Gynecol.* 2009;201(3):273.e1-273.e2739. doi:10.1016/j.ajog.2009.06.007

3. Sobhy S, Arroyo-Manzano D, Murugesu Net al. Maternal and perinatal mortality and complications associated with caesarean section in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet.* 2019;393(10184):1973-1982. doi:10.1016/S0140-6736(18)32386-9

Epidemiology: CS Mortality

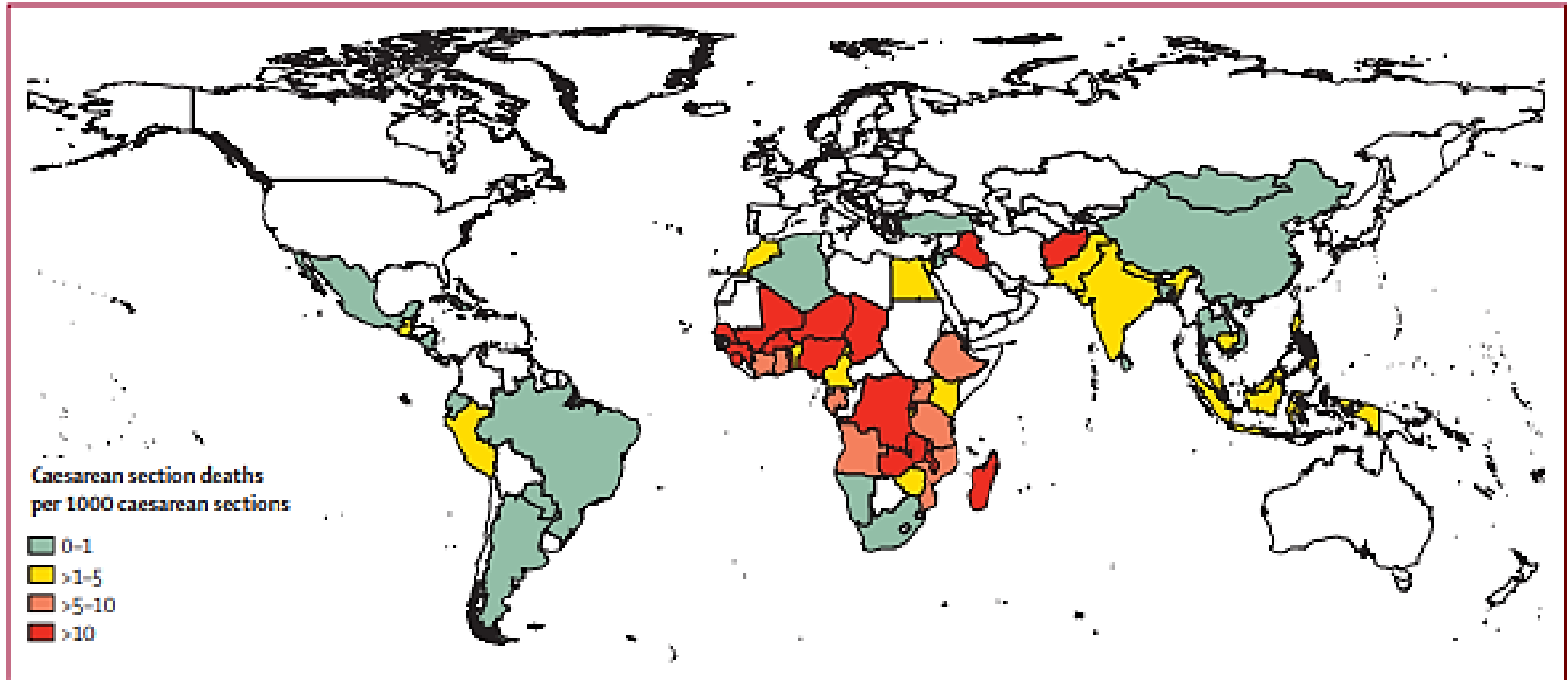


Figure 3: World map of maternal death risk following caesarean section in women from low-income and middle-income countries

3. Sobhy S, Arroyo-Manzano D, Murugesu N, et al. Maternal and perinatal mortality and complications associated with caesarean section in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet*. 2019;393(10184):1973-1982. doi:10.1016/S0140-6736(18)32386-9

Epidemiology: CS Mortality

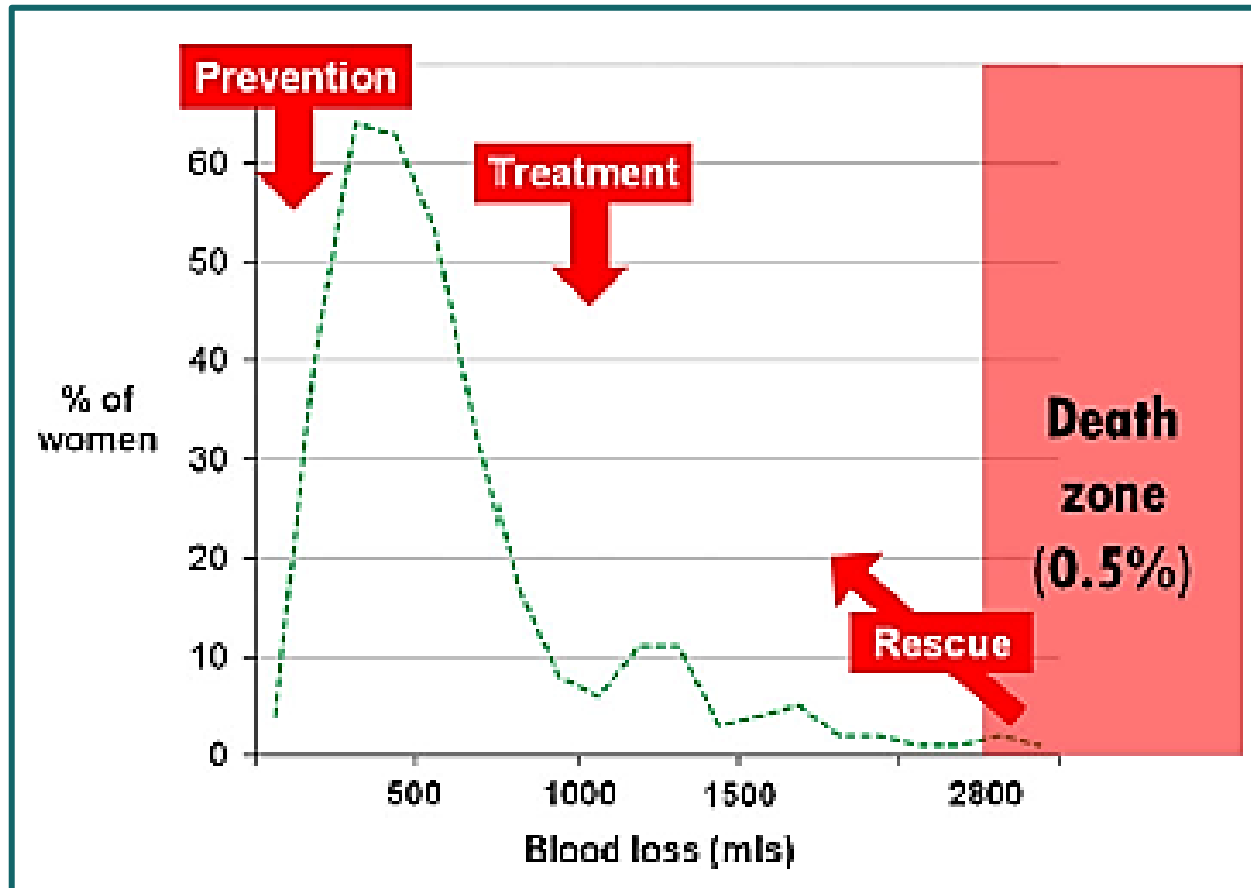
- Maternal death after cesarean delivery is 50 -100x more in LMICs than in high-income countries^{3,4}
- **25%** of all women who died in LMICs had undergone a CS
- **32%** of all maternal deaths following CS was attributed to PPH; 19% to pre-eclampsia/eclampsia and 22% to sepsis



3. Sobhy S, Arroyo-Manzano D, et al. Maternal and perinatal mortality and complications associated with caesarean section in low-income and middle-income countries: a systematic review and meta-analysis. *The Lancet*. 2019

4. Bishop D, Dyer RA, Maswime S, et al. Maternal and neonatal outcomes after cesarean delivery in the African Surgical Outcomes Study: a 7-day prospective observational cohort study. *The Lancet*. 2019; 7: 513-522. doi: [10.1016/S2214-109X\(19\)30036-1](https://doi.org/10.1016/S2214-109X(19)30036-1)

Importance of Anticipation, Early Recognition and Active Management of Haemorrhage



5. Weeks A. (2015). The prevention and treatment of postpartum haemorrhage: what do we know, and where do we go to next?. *BJOG : an international journal of obstetrics and gynaecology*, 122(2), 202–210.
<https://doi.org/10.1111/1471-0528.13098>.

Common Causes of PPH at CS

Do the **traditional 4 Ts** still apply to CS?

- **Tone - Atony** (due to, e.g., prolonged/obstructed labor, overdistended uterus, chorioamnionitis, placental abruption)
- **Tissue - Abnormal placentation** (e.g., placenta previa, placental abruption, placenta accreta/increta/percreta)
- **Trauma** (e.g., lacerations/tears, uterine rupture); impacted head
- **Thrombin - Abnormal coagulation** (e.g., severe preeclampsia/eclampsia, placenta abruption, hypofibrinogenemia, DIC)
- Risk factors: preterm birth, obesity, fibroids, general anesthesia



Detection of haemorrhage at CS

- Intra-op vs Post-op
- **Measures and outcomes for detection vary** and may include: estimated or measured volume of blood loss, physiological changes and the need for intervention.⁶
- **Visual method** of estimating blood loss is **imprecise** and hindered by **subjectivity** and **does not** always **match** the **clinical status** of patients.⁷
- **Objective methods** such as measured blood loss by the use of graduated collecting drapes and weighing of swabs are increasingly being used.⁸ Evidence on their use is evolving.



6. Natrella M, Di Naro E, Loverro M, Benshalom-Tirosh N, Trojano G, Tirosh D, et al. The more you lose the more you miss: accuracy of postpartum blood loss visual estimation. A systematic review of the literature. J Matern Fetal Neonatal Med [Internet]. 2017/01/12. 2018 Jan;31(1):106–15. Available from: <https://pubmed.ncbi.nlm.nih.gov/28002983>

7. ACOG. Quantitative Blood Loss in Obstetric Hemorrhage. Obstet Gynecol. 2019;134(6):1368–9.

8. Diaz V, Abalos E, Carroli G. Methods for blood loss estimation after vaginal birth. Cochrane Database Syst Rev. 2018;2018(9).

Developing algorithms for managing haemorrhage at CS

- Building the evidence
- Bringing all the pieces together
- Currently better evidence for preventing and managing PPH at vaginal birth than at CS

Prevention of PPH at CS

Uterotonics for prevention of PPH at CS:^{9,10}

- **Oxytocin**
- **Ergometrine + Oxytocin**
- Consideration for **Carbetocin**, especially where quality of oxytocin is a concern
 - › more effective than oxytocin

Is there a role for **prophylactic TXA**? For all CS or for those at high risk?

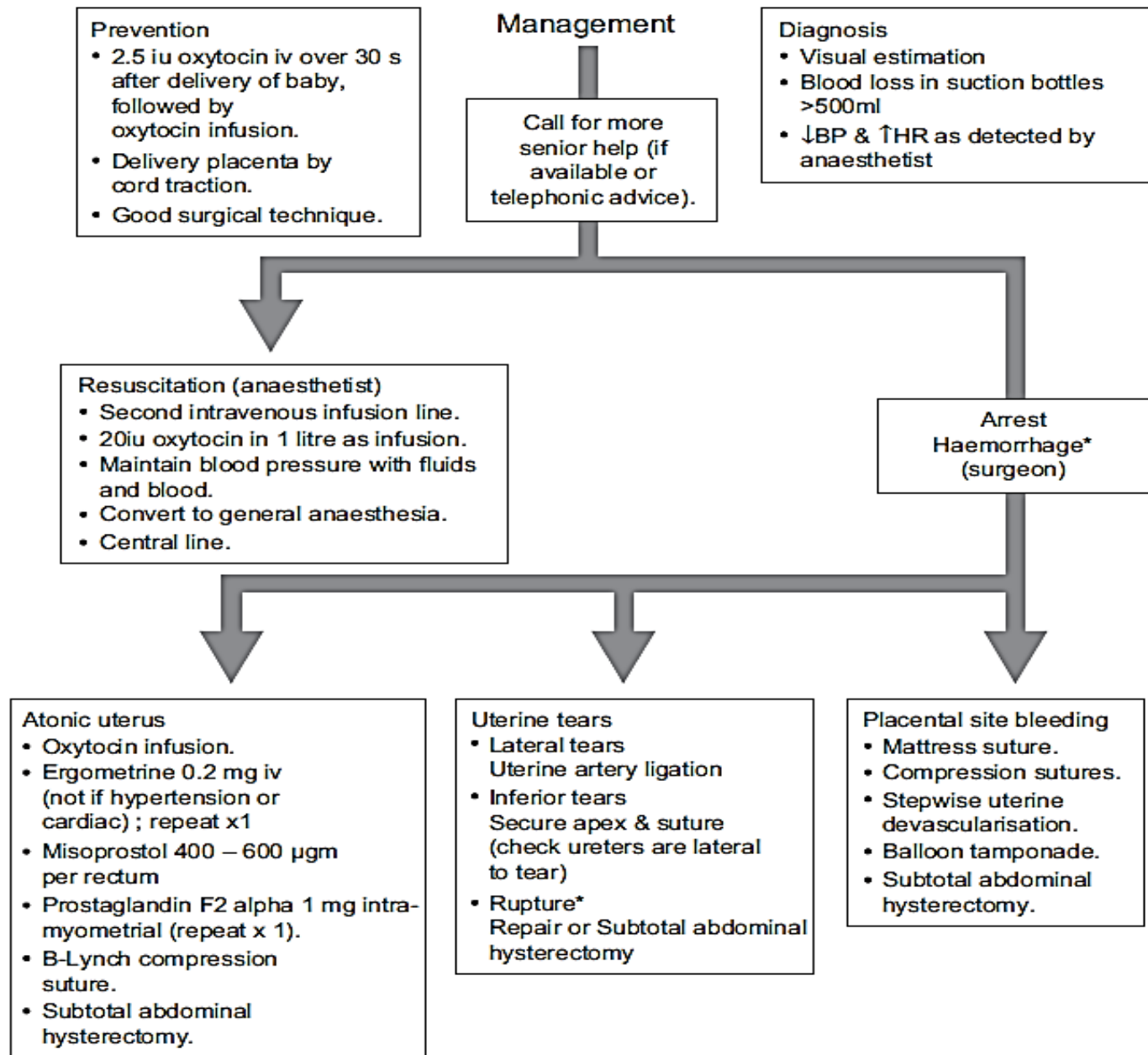
- Blood loss, massive hemorrhage, transfusion requirements, and need for additional uterotonics all markedly reduced¹¹

9. Gallos ID, Papadopoulou A, Man R, et al. Uterotonic agents for preventing postpartum haemorrhage: a network meta-analysis. *Cochrane Database Syst Rev*. 2018;12(12):CD011689. Published 2018 Dec 19. doi:10.1002/14651858.CD011689.pub3

10. Gallos I, Williams H, Price M, et al. Uterotonic drugs to prevent postpartum haemorrhage: a network meta-analysis. *Health Technol Assess*. 2019;23(9):1-356. doi:10.3310/hta23090

11. Wang Y, Liu S, He L. Prophylactic use of tranexamic acid reduces blood loss and transfusion requirements in patients undergoing cesarean section: A meta-analysis. *J Obstet Gynaecol Res*. 2019;45(8):1562-1575. doi:10.1111/jog.14013

Bleeding At Caesarean Section



12. Fawcus, S., & Moodley, J. (2013). Postpartum haemorrhage associated with caesarean section and caesarean hysterectomy. *Best practice & research. Clinical obstetrics & gynaecology*, 27(2), 233–249. <https://doi.org/10.1016/j.bpobgyn.2012.08.018>

13. Fawcus S. (2019). Practical approaches to managing postpartum haemorrhage with limited resources. *Best practice & research. Clinical obstetrics & gynaecology*, 61, 143–155. <https://doi.org/10.1016/j.bpobgyn.2019.03.009>

Fig. 1. Bleeding at caesarean section. * Proceed immediately to subtotal abdominal hysterectomy if uterine rupture is irreparable or placenta increta or perceta occur. STAH, subtotal abdominal hysterectomy.

Bleeding At Caesarean Section

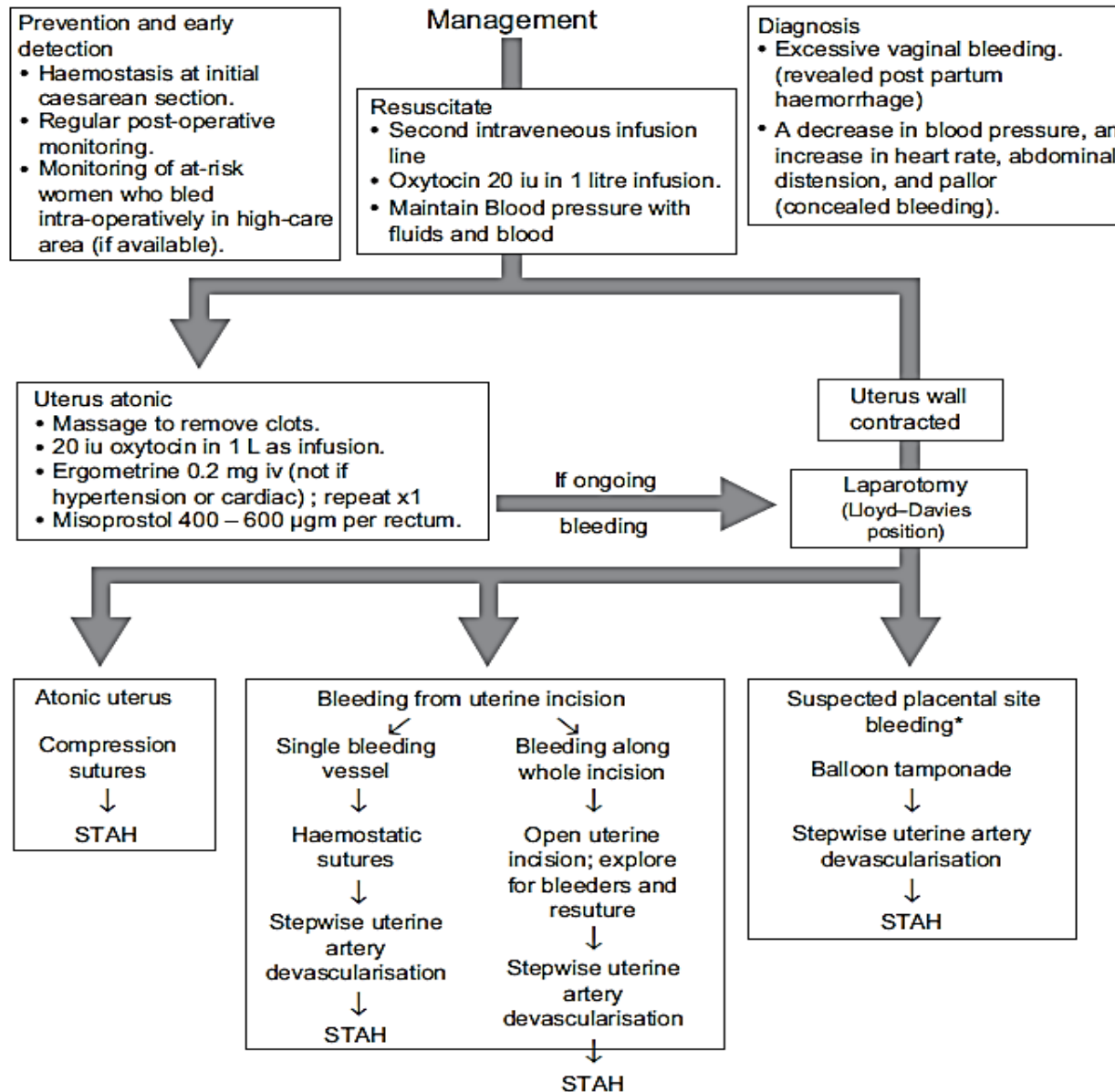


Fig. 2. Bleeding after caesarean section. * Proceed immediately to subtotal abdominal hysterectomy if the woman is very unstable. STAHL, subtotal abdominal hysterectomy.

12. Fawcus, S., & Moodley, J. (2013). Postpartum haemorrhage associated with caesarean section and caesarean hysterectomy. *Best practice & research. Clinical obstetrics & gynaecology*, 27(2), 233–249. <https://doi.org/10.1016/j.bpobgy.n.2012.08.018>

13. Fawcus S. (2019). Practical approaches to managing postpartum haemorrhage with limited resources. *Best practice & research. Clinical obstetrics & gynaecology*, 61, 143–155. <https://doi.org/10.1016/j.bpobgy.n.2019.03.009>

Surgical Management of PPH at CS

- When medical management of uterine atony fails
- When other causes are present (e.g., trauma - ruptured uterus/tears; abnormal placentation)

Note: Evidence for medical management of PPH at CS tends to be of higher quality than that for surgical management

Keys to Successful Surgical Management of PPH at CS

- Anticipation
- Early identification and management according to cause
- Use of CS adapted WHO Surgical Safety Checklist
- Situational awareness in the OT, teamwork and communication
 - ✓ These non-technical skills have been shown to be essential for improved team performance and improved outcomes^{14,15}
- Early decision to use compression sutures (e.g. B-Lynch) for uterine atony PPH
- Post-op care and monitoring

14. Stone JL, Aveling EL, Fream M, et al. 2017. Effective Leadership of Surgical Teams: A Mixed Methods Study of Surgeon Behaviors and Functions. *Ann Thorac Surg.* 104(2):530–537.

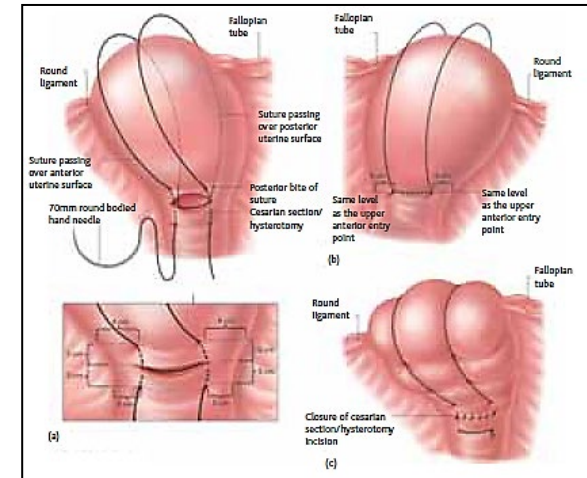
15. Brogaard L, Kierkegaard O, Hvidman L, Jensen KR, Musaeus P, Ulbjerg N, Manser T. The importance of non-technical performance for teams managing postpartum haemorrhage: video review of 99 obstetric teams. *BJOG* 2019;126:1015–1023.

Why B-Lynch Suture?

- Fast to perform: < 2 minutes
- Easy to learn – easy to practice on simulator
- Does not require special equipment or supplies
- Effectiveness: generally **75 – 90%**^{16,17}
- Most studied method (compare to Cho, Hayman, other modifications)
- No apparent impact on infertility

Considerations:

- Do *not* use permanent suture – risk of bowel herniation/strangulation
- Some concerns regarding risk of uterine necrosis if combined with devascularization sutures



16. Kaya B, Tuten A, Daglar K, et al. B-Lynch uterine compression sutures in the conservative surgical management of uterine atony. *Arch Gynecol Obstet*. 2015;291(5):1005-1014. doi:10.1007/s00404-014-3511-2

17. El-Sokkary M, Wahba K, El-Shahawy Y. Uterine salvage management for atonic postpartum hemorrhage using "modified lynch suture". *BMC Pregnancy Childbirth*. 2016;16(1):251. Published 2016 Aug 27. doi:10.1186/s12884-016-1000-2

Haemorrhage during and after caesarean section: Where do we go from here?

E-MOTIVE study – CS arm

- › Develop a strategy for early detection and management of PPH at CS (bundles + algorithms)
- › Develop a strategy for implementation

**Saving lives.
Improving health.
Transforming futures.**

The Importance of Non-technical skills

John Varallo

Surgical Non-technical Skills

- Defined as the **social (leadership, teamwork and communication)** and **cognitive (situational awareness and decision making) skills** that support the technical skills (clinical knowledge and surgical skills) to perform safe surgery.¹⁸



18. Yule S, Flin R, Paterson-Brown S, Maran N, Rowley D. Development of a rating system for surgeons' non-technical skills. *Medical education*. 2006;40(11):1098-1104. <https://api.istex.fr/ark:/67375/WNG-G93LF0SV-J/fulltext.pdf>. doi: 10.1111/j.1365-2929.2006.02610.x.

Why focus on non-technical skills?

- Providing safe, high-quality care requires effective teamwork and communication within and across healthcare teams and organizations.¹⁹
- The impact on poor surgical outcomes from ineffective teamwork and communication is exacerbated in the operating room (OR), where entrenched professional hierarchies can be potent barriers.
- Ineffective communication between surgical team members has been shown to be a cause of more than 50% of intraoperative surgical errors.²⁰
- Strengthening non-technical skills helps prevent perioperative complications and death.^{21,22}



19. Rosen MA, DiazGranados D, Dietz AS, Benishek LE, Thompson D, Pronovost PJ, Weaver SJ. Teamwork in healthcare: Key discoveries enabling safer, high-quality care. *Am Psychol*. 2018 May-Jun;73(4):433-450. doi: 10.1037/amp0000298. PMID: 29792459; PMCID: PMC6361117.

20. Gawande AA, Zinner MJ, Studdert DM, Brennan TA. Analysis of errors reported by surgeons at three teaching hospitals. *Surgery*. 2003;133(6):614-621. <https://dx.doi.org/10.1067/msy.2003.169>. doi: 10.1067/msy.2003.169.

21. Christian CK, Gustafson ML, Roth EM, et al. A prospective study of patient safety in the operating room. *Surgery*. 2006;139(2):159-173. <https://dx.doi.org/10.1016/j.surg.2005.07.037>. doi: 10.1016/j.surg.2005.07.037.

22. Catchpole KR, Giddings, Anthony E.B., et al. Improving patient safety by identifying latent failures in successful operations. *Surgery*. 2007;142(1):102-110. <https://www.clinicalkey.es/playcontent/1-s2.0-S0039606007001249>. doi: 10.1016/j.surg.2007.01.033.

Non-Technical Skills for Surgeons (NOTSS) framework

- Developed with surgical teams, educators, and researchers in mind to improve behaviors in the OR (i.e., the social and cognitive skills) that improve performance and patient safety²³. NOTSS emphasizes a multidisciplinary team-based approach to training and surgical care to increase surgical safety and quality.

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situation Awareness		Gathering information		
		Understanding information		
		Projecting and anticipating future state		
Decision Making		Considering options		
		Selecting and communicating option		
		Implementing and reviewing decisions		
Communication and Teamwork		Exchanging information		
		Establishing a shared understanding		
		Co-ordinating team activities		
Leadership		Setting and maintaining standards		
		Supporting others		
		Coping with pressure		

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Applicable

1 Poor Performance endangered or potentially endangered patient safety, serious remediation is required
 2 Marginal Performance indicated cause for concern, considerable improvement is needed
 3 Acceptable Performance was of a satisfactory standard but could be improved
 4 Good Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
 N/A Not Applicable

²³The non-technical skills for surgeons (NOTSS) structuring observation, feedback and rating of surgeons' behaviours in the operating theatre system handbook v2.0. .

The WHO Surgical Safety Checklist

- In 2008 - 2009, WHO developed and introduced the SSC, a simple **19-item checklist** designed to improve **teamwork and communication and adherence to essential safety stops**, with the goal to improve patient safety during surgery.²⁴
- The **three pause points** in the SSC (Sign In, Time Out, and Sign Out), **prompt and foster discussion amongst team members** and establishing a shared mental model of the surgical team members.
- Decreases perioperative complications and death by 30-50%.^{25,26}

Surgical Safety Checklist		
Before induction of anaesthesia	Before skin incision	Before patient leaves operating room
(with at least nurse and anaesthetist)	(with nurse, anaesthetist and surgeon)	(with nurse, anaesthetist and surgeon)
<p>Has the patient confirmed his/her identity, site, procedure, and consent?</p> <input type="checkbox"/> Yes	<p><input type="checkbox"/> Confirm all team members have introduced themselves by name and role.</p> <p><input type="checkbox"/> Confirm the patient's name, procedure, and where the incision will be made.</p> <p>Has antibiotic prophylaxis been given within the last 60 minutes?</p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<p>Nurse Verbally Confirms:</p> <input type="checkbox"/> The name of the procedure <input type="checkbox"/> Completion of instrument, sponge and needle counts <input type="checkbox"/> Specimen labelling (read specimen labels aloud, including patient name) <input type="checkbox"/> Whether there are any equipment problems to be addressed
<p>Is the site marked?</p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<p>Anticipated Critical Events</p> <p>To Surgeon:</p> <input type="checkbox"/> What are the critical or non-routine steps? <input type="checkbox"/> How long will the case take? <input type="checkbox"/> What is the anticipated blood loss?	<p>To Surgeon, Anaesthetist and Nurse:</p> <input type="checkbox"/> What are the key concerns for recovery and management of this patient?
<p>Is the anaesthesia machine and medication check complete?</p> <input type="checkbox"/> Yes	<p>To Anaesthetist:</p> <input type="checkbox"/> Are there any patient-specific concerns?	
<p>Is the pulse oximeter on the patient and functioning?</p> <input type="checkbox"/> Yes	<p>To Nursing Team:</p> <input type="checkbox"/> Has sterility (including indicator results) been confirmed? <input type="checkbox"/> Are there equipment issues or any concerns?	
<p>Does the patient have a:</p> <p>Known allergy?</p> <input type="checkbox"/> No <input type="checkbox"/> Yes	<p>Is essential imaging displayed?</p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	
<p>Difficult airway or aspiration risk?</p> <input type="checkbox"/> No <input type="checkbox"/> Yes, and equipment/assistance available		
<p>Risk of >500ml blood loss (7ml/kg in children)?</p> <input type="checkbox"/> No <input type="checkbox"/> Yes, and two IVs/central access and fluids planned		

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged. Revised 1 / 2009 © WHO, 2009




²⁴WHO Patient Safety, World Health Organization. WHO guidelines for safe surgery : 2009 :Safe surgery saves lives. . 2009

²⁵Haynes AB, Weiser TG, Berry WR, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. *The New England Journal of Medicine*. 2009;360(5):491-499. <http://content.nejm.org/cgi/content/abstract/360/5/491>. doi: 10.1056/NEJMsa0810119.

²⁶Ademuyiwa AO, Medina AR, Nawara C, et al. Pooled analysis of WHO surgical safety checklist use and mortality after emergency laparotomy. *British journal of surgery*. 2019;106(2):e103-e112. <https://onlinelibrary.wiley.com/doi/abs/10.1002/bjs.11051>. doi: 10.1002/bjs.11051.

SSC: Anticipating and planning for hemorrhage

Surgical Safety Checklist		
 World Health Organization Patient Safety <small>A World Alliance for Safe Health Care</small>		
Before induction of anaesthesia	Before skin incision	Before patient leaves operating room
<small>(with at least nurse and anaesthetist)</small>	<small>(with nurse, anaesthetist and surgeon)</small>	<small>(with nurse, anaesthetist and surgeon)</small>
<p>Has the patient confirmed his/her identity, site, procedure, and consent?</p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<p><input type="checkbox"/> Confirm all team members have introduced themselves by name and role.</p> <p><input type="checkbox"/> Confirm the patient's name, procedure, and where the incision will be made.</p> <p>Has antibiotic prophylaxis been given within the last 60 minutes?</p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<p>Nurse Verbally Confirms:</p> <input type="checkbox"/> The name of the procedure <input type="checkbox"/> Completion of instrument, sponge and needle counts <input type="checkbox"/> Specimen labelling (read specimen labels aloud, including patient name) <input type="checkbox"/> Whether there are any equipment problems to be addressed
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<p>Is the anaesthesia machine and medication check complete?</p> <input type="checkbox"/> Yes		
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<p>Risk of >500ml blood loss (7ml/kg in children)?</p> <input type="checkbox"/> No <input type="checkbox"/> Yes, and two IVs/central access and fluids planned		

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged. Revised 1 / 2009 © WHO, 2009

Risk of >500ml blood loss (7ml/kg in children)?

- No
- Yes, and two IVs/central access and fluids planned

Anticipated Critical Events

To Surgeon:

- What are the critical or non-routine steps?
- How long will the case take?
- What is the anticipated blood loss?

To Anaesthetist:

- Are there any patient-specific concerns?

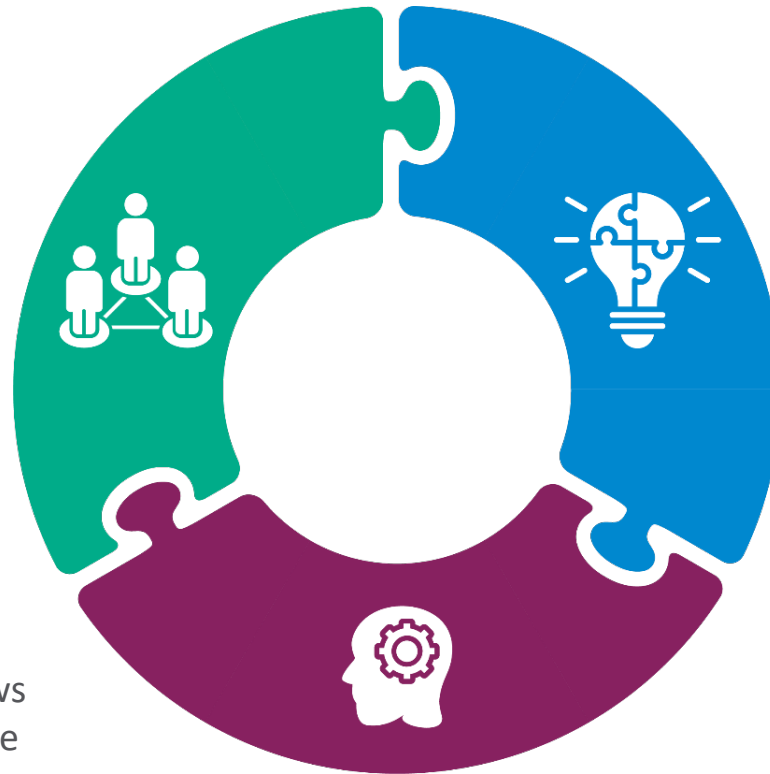
To Surgeon, Anaesthetist and Nurse:

- What are the key concerns for recovery and management of this patient?

Teamwork/Communication and Building a Culture of Patient Safety

TEAMWORK

“We work as a TEAM.”



PATIENT SAFETY

“The Surgical Safety Checklist is changing practice and culture in surgery.”

“The patient doesn’t belong to one person.”

CONFLICT-SOLVING

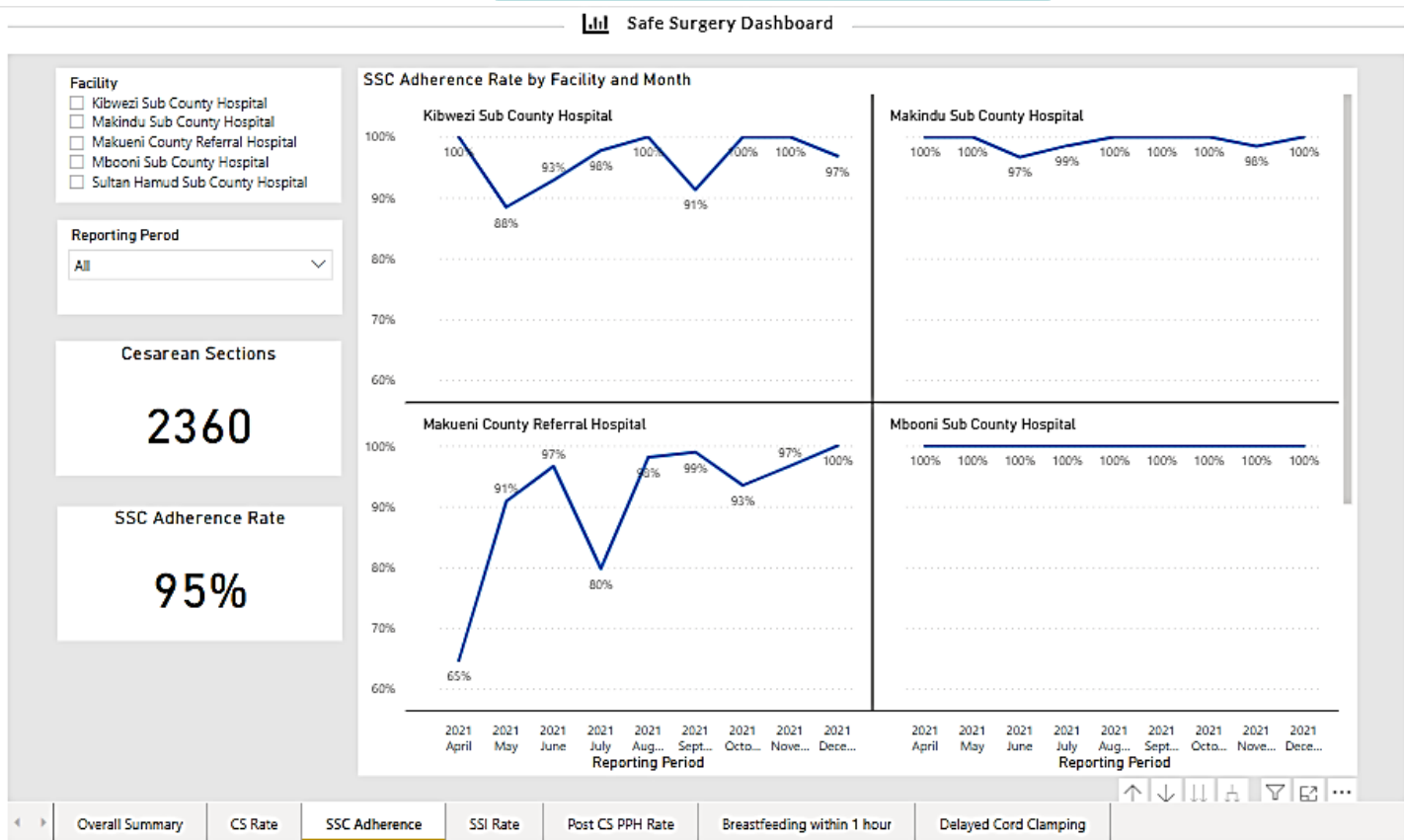
“We now have the skills to deal with conflicts.”

ACCOUNTABILITY

“Every individual knows their role to play in the OR.”

Kenya Obstetric Safe Surgery: Dashboard

SSC Adherence at CS

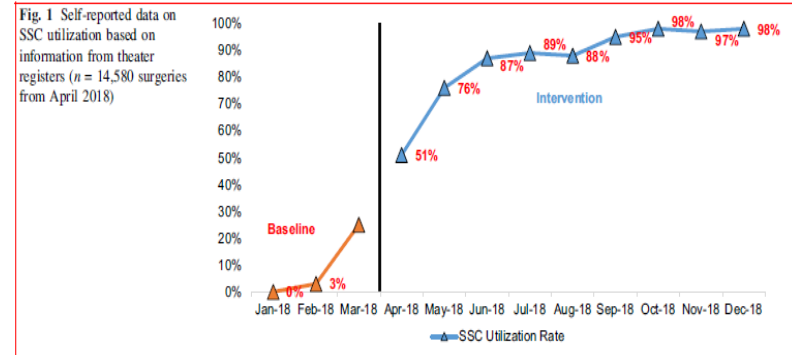


Improving SSC adherence and improving outcomes

- **SSC adherence (self-report) improved from 0% at baseline to 98% and sustained¹**
- **Close correlation with chart audit and direct observation¹**
- **SSC adherence increased from 3.7% to 95.1%²**
- **SSI after CS reduced from 14% at baseline to 1%²⁷**
- **CS-related POMR (deaths) decreased by 38.5%²⁸**

27. Hellar A., Tibehebaw L., Ernest E., Varallo, J, et al. (2020). A Team-Based Approach to Introduce and Sustain the Use of the WHO Surgical Safety Checklist in Tanzania. *World journal of surgery*, 44(3), 689–695. <https://doi.org/10.1007/s00268-019-05292-5>

28. Ernest, E., Hellar A., Varallo, J, Tibehebaw L., et al. (2021). Reducing surgical site infections and mortality among obstetric surgical patients in Tanzania: a pre-evaluation and postevaluation of a multicomponent safe surgery intervention. *BMJ global health*, 6(12), e006788. <https://doi.org/10.1136/bmjgh-2021-006788>



Hellar, et al WJS 2019

Original research

BMJ Global Health Reducing surgical site infections and mortality among obstetric surgical patients in Tanzania: a pre-evaluation and postevaluation of a multicomponent safe surgery intervention

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ABSTRACT
Introduction: Despite ongoing maternal health interventions, maternal deaths in Tanzania remain high. One of the main causes of maternal mortality includes postoperative infections. Surgical site infection (SSI) rates are higher in low-income countries (LMIC), such as Tanzania, compared with high-income countries. We evaluated the impact of a multicomponent safe surgery intervention in Tanzania, hypothesising it would increase adherence to safety practices, such as the WHO Surgical Safety Checklist (SSC), reduce CS-related postoperative mortality rates (POMR), and reduce CS-related surgical site infections (SSI) and CS-related SSI rates (POMR).
Methods: We conducted a pre- and post-evaluation cross-sectional study design to evaluate WHO SSC adoption, SSI rates and CS-related POMR before and 18 months after implementation. Our interventions included training of anaesthetists and surgical teams, providing WHO SSC and introducing an infection prevention (IP) bundle for all CS patients. We assessed use of WHO SSC and SSI rates through random sampling of 379 individual CS patient files. We measured compliance and need for antibiotics, related the number of CS performed and CS-related deaths. We compared proportions of individuals with a characteristic of interest before implementation and post implementation using the binomial proportion test at p<0.05 using SPSS V15.0.
Results: The SSC adoption rate for CS increased from 3.7% at start of 2018 to 95.1% (136 out of 143 with CS) reduced from 14% during baseline to 1% (p<0.001). The change in SSI rates after the implementation of the safe surgery intervention is statistically significant (p<0.001). The CS-related POMR decreased by 38.5% (p<0.001) after the implementation of safe surgery interventions.
Conclusions: Our findings show that our intervention led to improved utilisation of the WHO SSC, reduced SSI and a drop in CS-related POMR. We recommend replication of the interventions in other LMICs.

What is already known?
 • Postoperative complications are a significant contributor to mortality among surgical patients in low middle-income countries.
 • Use of the WHO Surgical Safety Checklist (SSC) reduces the risk of complications and death from surgery and enhances patient safety by promoting best practice and standardising essential surgical practices.
 • Several studies have provided evidence on the significance of global recommended best practices to reduce caesarean section (CS)-related complications.
 • These practices include infection prevention (IP) bundles, use of oral Cefazolin sodium, and implementation of Early Recovery After Surgery practice.
What are the new findings?
 • The implementation of the global recommended best practices to reduce CS-related complications in low-income settings such as Tanzania is feasible, low-cost and high-impact.
 • The implementation of the WHO SSC and the introduction of an infection prevention bundle, as well as the implementation of the Early Recovery After Surgery practice, on the acceptance and utilisation of the WHO SSC among surgical services providers.
What are the new findings?
 • We demonstrated that a multicomponent team-based approach is effective in promoting WHO SSC adoption, reducing surgical complications, and improving patient satisfaction along with incorporating evidence-based clinical updates, for example, the IP bundle.
 • Based on this evidence, it is therefore possible to scale up these interventions in other low-income settings including Tanzania and achieve the reduction in caesarean related complications and mortality.

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Key Takeaways

- CS is a significant risk for haemorrhage and maternal mortality
- It is essential that PPH programs include surgical management of PPH and managing haemorrhage at CS
- Evidence is building for the most appropriate CS PPH bundles and algorithms, but more research is needed
- B-Lynch uterine compression suture is an attractive surgical method to include in any program that provides CS services, especially where non-specialists work
- Successful implementation of algorithms and technical skills requires essential non-technical skills that are often overlooked

Thank You!!

Questions?