

BMJ Open Quality Use of quality improvement methodology to improve care of women with hypertensive disease in pregnancy and haemorrhage in Yemen (low-income, high-insecurity setting)

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ABSTRACT

This safety improvement project used quality improvement methods in a Comprehensive Emergency Obstetric and Newborn Care facility in Yemen, managed by an international humanitarian non-governmental organisation. It is responsible for about 6500 deliveries per annum. Following a local review of maternal deaths and serious incidents in 2020–2021, care for women with severe hypertensive disease in pregnancy and postpartum haemorrhage were highlighted as potential areas for improvement. These are also the two most common reasons recorded for maternal mortality in Yemen (and in many low-income countries worldwide). We also wanted to foster an open and honest safety culture within the department that encouraged learning from error. We used an inclusive approach in designing the improvements, with change ideas collated via frontline doctors, midwives and nurses working in the maternity unit. Data were collected via manual audit, and through routinely collected data. We focused on the following measures: number of incidents reported per month, documentation quality of antihypertensive prescriptions, fluid restriction practices in women with severe pre-eclampsia, number of minutes taken to control severe hypertensive episodes, postpartum haemorrhage identification rates and tranexamic acid stock usage. We evaluated the efficacy of team simulation training through precourse and postcourse questionnaires. We found demonstrable improvement in our measures relating to treatment of women with hypertensive disorders of pregnancy, and in postpartum haemorrhage identification and treatment. Team simulation training was a difficult intervention to sustain but was received well with positive results during our test session. Incident reporting showed a temporary increase, but this effect was not sustained.

We concluded that quality improvement methodology is a valuable tool even in challenged healthcare settings such as this one, in an active conflict zone. Behaviour change in team culture and safety culture is harder to sustain and demonstrate without a long-term strategy.

PROBLEM

Since March 2015, Yemen has been embroiled in a civil war. The chronic effects of war have

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Complications of hypertensive disease in pregnancy and from postpartum haemorrhage are common in low-income countries and form the leading causes of maternal death worldwide.
- ⇒ Chronic war and political instability can result in healthcare settings operating in conflict areas for years, with a subsequent need for clinical governance structures and opportunities to apply continuous quality improvement.

WHAT THIS STUDY ADDS

- ⇒ This study applies quality improvement methods in a low-income, high-insecurity context, aiming to improve the adherence to established clinical protocols in the management of pregnancy complicated by haemorrhage and hypertensive disorders.
- ⇒ We have shown the feasibility of doing quality improvement work in conflict zones, and the importance of applying rigour of method.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Even in low-resourced healthcare settings and those situated in challenging contexts such as conflict zones, basic principles of what is known on leadership, engagement and change management can and should be applied.
- ⇒ Investment in quality improvement training and expertise among clinical leadership in humanitarian settings may be helpful in establishing culture and rigour of continuous quality improvement.

left the health system collapsed and there is a reliance on international humanitarian agencies to deliver basic medical care.¹ Taiz-Houban Mother and Child Hospital (MCH) is a maternity and child health secondary referral hospital managed by an international humanitarian non-governmental organisation. It has provided maternity care to the local population since the start of the conflict.



The socio-economic situation due to the war has only worsened due to the COVID-19 pandemic. Up to 80% of the population live below the poverty line. There are about 4 million internally displaced persons in Yemen, 92% of whom report not having any income at all or living with <25 000 Yemeni Riyals (US\$ 40) per month.²

The poor primary care infrastructure and deprioritisation of public health needs during the war, together with barriers in access to care such as insecurity, affordability of transport (all care provided at MCH is free of charge) and cultural factors (use of traditional healers and delayed presentation) mean that the population of pregnancy women who attend MCH tend to have little or no antenatal care and often present in extremis.

There is no indication that the international non-governmental organisation will be able to withdraw support from Taiz Houban region, and thus there is a need to assess and maintain clinical quality standards at MCH. The short-term (4months) availability of expertise in quality improvement (QI) at MCH through the arrival of an International Obstetrician and Gynaecologist (ObGyn) with a QI background presented an opportunity to apply this methodology to reduce variation of practice, raise standards of care and identify systemic safety issues in a socially, politically and economically challenging context.

BACKGROUND

The two main direct causes of maternal death in Yemen are haemorrhage (33%) and hypertensive disease of pregnancy (13%). Together, they comprise 46% of all maternal deaths.³

The rates of maternal mortality studied in 2016, after the onset of the war, have shown an increase in all Yemeni governorates. The national average of 213.4 deaths per 100 000 live births in 2016 had increased by 1.3% since 2013. In Taiz governorate, there was a 2.4% increase from 2013 to 2016.⁴

Measuring quality in the low-income, high-insecurity setting is challenging, let alone attempts at improving quality measures.^{5,6}

MCH is a Comprehensive Emergency Obstetric and Newborn Care (CEmONC) facility. It is responsible for about 6500 deliveries per annum, with an approximate caesarean delivery rate of 13%. There is an en site neonatal unit that operates at the level of a special care baby unit (no invasive respiratory support), a therapeutic feeding centre and an emergency department that sees patients with trauma and injuries, as well as children and pregnant women. At the start of the COVID-19 pandemic, an alongside respiratory unit that sees children and pregnancy women with respiratory symptoms was opened. Patients who are thought to be unwell from COVID-19 are transferred to a referral hospital in the region. Intensive care facilities for mothers and babies are available in a nearby private hospital.

In our local review of maternal deaths at MCH, occurring between February 2020 and March 2021, we identified six maternal deaths; 4/6 were complicated by maternal haemorrhage and 2/6 were complicated by hypertensive disease. There were recurrent themes identified in review of these sentinel cases:

- ▶ Delay in recognition of unwell women and subsequent delay in escalation of care.
- ▶ Communication problems between team members and delayed involvement of the multidisciplinary team.
- ▶ Poor fluid management.

Inadequate documentation, a lack of discipline with drug prescribing practice and slow response to acutely raised blood pressure were also highlighted through case review of serious incidents reported in 2020–2021 and were norms that were observed in the department.

MEASUREMENT

As a maternity service, MCH is a mature service, and has been running over the past 7years since the start of the conflict. The operational team in 2015 had been focusing on getting the structural elements in place (pharmacy, operating theatre, ward spaces, equipment, energy supply, water sanitation, human resources, etc). These are largely running smoothly now.

Regarding outcome measures for quality, the project has a data team that compiles outcome data for maternal mortality, neonatal mortality, admission rate from the maternity unit to the neonatal unit, transfer rate to intensive care and other outcome measures. These broad measures are difficult to use in the context as a measurement of quality as the hospital only receives high-risk cases. There is a strict admission criteria and obstetric triage system at the door to identify women who are low risk, who are redirected to other local health centres.

Thus, we have chosen to focus on key process measures where we feel maximum impact can be felt downstream in eventually improving maternal morbidity and mortality. We used a maternal death local review and root cause analysis process, and a similar process applied to clinical incident case reviews to determine which process measures we wished to focus on. In line with the Institute for Healthcare Improvement (IHI) Framework for Safe and Reliable Healthcare,⁷ we attempted to measure staff culture and key human factor indicators alongside our clinical process measures.

The IHI model for improvement⁸ is a simple and effective methodology for QI well established in healthcare settings. With our desire to shift the focus onto quality of care through evaluation of key process measures, we decided to use the IHI model and successive Plan-Do-Study-Act (PDSA) cycles to accomplish our objectives.

Global aims

1. Fostering a safety culture among staff, with an open and honest environment that encourages learning

from incidents, use of structured communication tools and accountability for unprofessional team behaviour.

2. Improve the management of pre-eclampsia and eclampsia.
3. Improve the management of postpartum haemorrhage (PPH).

Specific aims

1. Increase incident reporting.
2. Commence a programme of multiprofessional obstetric emergency drill training (with postcourse participants reporting increased confidence in key human factors skills such as communicating concerns and working well in a team).
3. Decrease errors in drug prescription.
4. Increase number of women with severe pre-eclampsia with hourly fluid input and output recorded, and fluid restriction carried out (in accordance with local protocols).
5. Increase number of women with severe pre-eclampsia with acute hypertension controlled in a stepwise manner and in a systematic way (in accordance with local protocols).
6. Increase number of women with PPH who have treatment in a systematic way, including use of tranexamic acid for estimated blood loss (EBL) >500 mL (in accordance with local protocols).
7. Increase PPH identification to enable effective management.

All measures had to be manually collected as there is no electronic patient record. PPH rates and stock levels of tranexamic acid are routinely collected and reported data were pulled from monthly reporting. Other measures had to be collected via manual auditing, apart from measuring team safety culture, which was reliant on staff filling in a questionnaire before and after the multiprofessional obstetric emergency skills simulation training day.

1. Number of incidents reported.
2. Staff confidence in key safety behaviours (eg, “I feel confident to communicate safety concerns”, “I feel confident in working within the team”), self-rated on a Likert scale.
3. Per cent of antihypertensive prescriptions with dose, timing and frequency clearly documented.
4. Per cent of women with severe pre-eclampsia who were fluid restricted.
5. Number of minutes taken to control severe hypertensive episode.
6. PPH rates (via clinical coding data).
7. Tranexamic acid stock usage.

DESIGN

The team involved in this improvement project comprised the International ObGyn who was present from March 2021 to July 2021, the International Midwife who was present from June 2021 to January 2022, the Hospital Director (International staff) who was present from June

2021 to February 2022 and the Medical Activity Manager (Yemeni national substantive staff member at MCH).

We tried to be inclusive in our approach in co-designing changes with staff, and constantly providing two-way feedback during daily ward rounds. Systemic issues were identified,

such as the difficulty in interpreting the drug chart due to its design, resulting in delayed or missed antihypertensive medication and the use of an out-of-date chart for magnesium sulfate prescription. Many inadequate practices were due to norms developing in the department and cultural challenges. For example, women were left on the floor on stretchers in the maternity department following transfer from the emergency room (ER), as the male stretcher carriers felt a pressure to leave the all-female maternity department as soon as possible. Following team conversations explaining the importance of getting women onto a trolley or into a delivery room, and explicit permission for male stretcher carriers to stay in the maternity department until this occurred, we observed some improvements.

Some clinical policies were introduced following consultation of the team leaders:

- ▶ Pink (20-gauge) cannulae were frequently used for maternity patients despite the local guidelines stating that only large bore cannulae should be used in the context of PPH. These were removed from the department and replaced with large bore cannulae.
- ▶ EBL was not routinely documented after every birth. EBL awareness posters aiding visual blood loss estimation were put on walls to try and remind staff to initiate the PPH protocol, including the administration of tranexamic acid⁹ once EBL exceeded 500 mL. BRASS-V drapes are blood collection drapes with a calibrated pouch to assist in more accurate blood loss estimation and were suggested by staff who had used them in other facilities.

Finally, as with many other safety improvement initiatives, we found that an education programme was a key driver to create a culture of learning and improvement from clinical cases. We trialled multiprofessional simulation training, weekly case presentations, circulation of safety messages using WhatsApp (most staff did not have an email address) and used teaching sessions as opportunities to generate engagement, change ideas and ownership of interventions. We wanted to increase incident reporting, and hence simplified the reporting form, rebranding them as ‘Quality Reporting’ forms that front-line staff were encouraged to fill in only basic details of cases that managers could then investigate.

The driver diagram in [figure 1](#) summarises the drivers and intervention ideas tried.

STRATEGY

Online supplemental table 1 shows the results of our PDSA cycles.

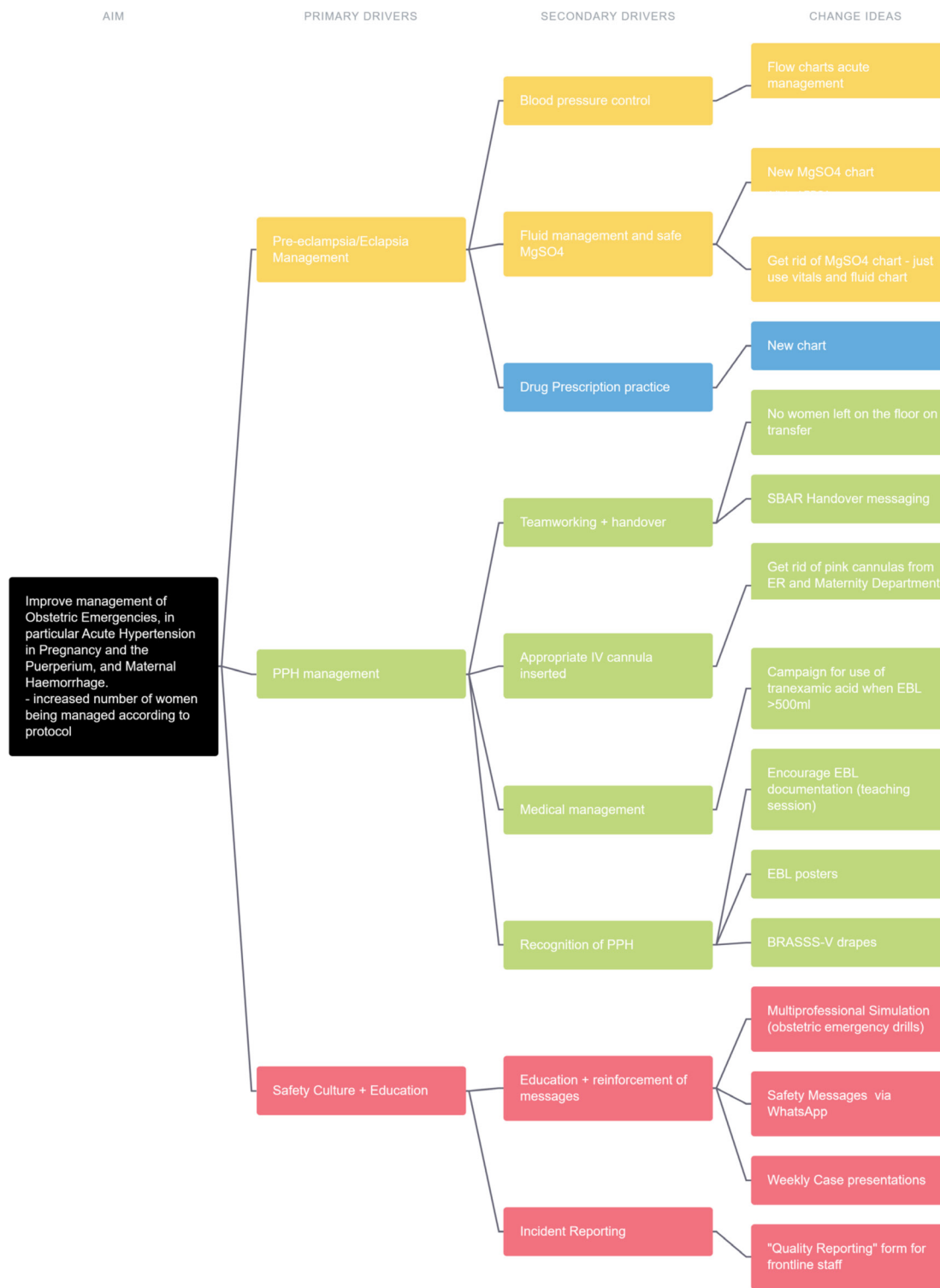


Figure 1 Driver Diagram.

Quantitative data were not collected following July 2021 as this is when the International ObGyn left the project. The International Midwife remained till January 2022 and feedback when she left the project was that EBL estimation was a sustained practice and that tranexamic acid use continued but there were continual issues with inadequate stock as the ordering practices would take time to catch up with prescribing practices.

Blood pressure control and fluid management were improved subjectively but we do not have numerical audit data to confirm sustainment of initial improvements.

Feedback from the Hospital Director in February 2022 was that incident reporting fell back to pre-intervention rates, with only one incident reported (at the request of the Hospital Director rather than from a frontline staff member). Behavioural interventions such as encouraging

systematic handover using the Situation-Background-Assessment-Recommendation (SBAR) tool and ensuring safe transfer of women from ER to maternity, were also difficult to measure improvement, and subjective assessment reported ongoing challenges with culture change.

We used run charts to plot and observe the effects of interventions on:

- ▶ Number of incidents reported.
- ▶ Tranexamic acid usage.
- ▶ PPH rates.

We used a statistical process control chart to plot and observe the effects of interventions on the control of blood pressure (number of minutes taken to control acute hypertensive event).

RESULTS

The results of each intervention described in our ‘Study of the Intervention’ and PDSA cycles show that the 4-month presence of the International ObGyn created educational opportunities, forums for team discussions and some structure for a risk management strategy in the department. The subsequent arrival of an International Midwife to do further work in midwifery education reinforced messages that led to demonstrable improvement in the management of acute hypertension and in PPH identification (see the embedded charts in online supplemental file 1 for more details).

Staff were very receptive to the improvement programme, and it was not difficult to engage staff in providing improvement ideas. Weekly case presentations were usually carried out at 16:00–17:00 hours, and the night shift staff (who started at 17:00 hours) would come in early before their shifts to attend the presentation. Some staff members attended teaching sessions on their days off.

Interventions that had a clear message had more success in sustained improvement. For example:

1. Give tranexamic acid when the EBL is >500 mL and start using mechanical methods to control bleeding.
2. When the systolic blood pressure is ≥ 160 or the diastolic blood pressure is ≥ 110 (in the red zone on the vitals chart), give an antihypertensive and recheck in 30 min. If still in the red zone, give another antihypertensive. Escalate treatment according to flow chart.

These messages were already well established and written down in the local protocol, which all staff had access to. Transcribing them onto simple flowcharts and emphasising the importance of following them on daily ward rounds and through critical case presentations helped staff follow the clear instructions that they all already knew they should be doing.

We struggled more with problems that required a cultural shift, or a behavioural change. For example, introduction of the SBAR tool for handover. Despite the SBAR tool being an organisation-wide adopted team communication tool, the training for this was not well attended (being a virtual lecture delivered in English via

video link) and staff found this form of communication difficult as it did not translate well into Arabic. Cultural issues, such as the barrier between men and women speaking to each other, are other challenges to consider when trying to improve team communication.

The idea of using multiprofessional obstetric emergency drill simulation training to open conversations between team members surrounding team working, handover and communication was limited by the ongoing lack of expertise in facilitation, simulation training and debrief. The International ObGyn had planned two sessions a month apart, with the aim to handover the work (including scenarios) to the International Midwife, and other national staff. The skills required to facilitate and conduct simulation training were harder to teach over this time period, and we only managed to do one session as the other had to be cancelled due to staffing shortages over Ramadan. The reflections from the single session carried out was documented in a blog article, which details the potential benefit of this approach, given more resource.¹⁰

BRASS-V drapes were a change idea proposed by one of the Yemeni national doctors, but we were unable to procure these. There were challenges particular to this context, where the supply chain is limited in a conflict area. Our issues with supply of tranexamic acid and other drugs were ongoing challenges.

Lessons and limitations

Our experience in doing this work found that broad principles of change management and leadership in more affluent contexts can also apply in this context. Psychologist Jonathan Haidt’s rider and the elephant analogy,¹¹ and Chip and Dan Heath’s triad for behavioural change¹² can be applied here:

1. Direct the rider: clear flow charts, visual blood loss estimation posters and simple messaging helped staff reduce the time taken to control acute hypertensive episodes, increased used of tranexamic acid in the management of PPH and increased identification of PPH.
2. Motivate the elephant: critical case presentations detailing the importance of blood pressure control and early identification of haemorrhage, including details of aftermath of incidents, built a clear case for change.
3. Shape the path: creating an environment where change was easier, through re-design of drug charts and vital signs charts, meant that error was less likely.

Overwhelming feedback from Yemeni national staff was that they desired opportunity for continued professional development, hence the engagement with any clinical educational sessions, and that they valued on the floor presence by senior management. They had many ideas for improvement and required a forum to air these ideas, and permission to enact them. The idea of the “Leader as a Coach”,¹³ where leaders and managers should move away from “command and control” and instead use coaching and empowerment to drive improvement and



performance, was found to be even more relevant in this context where the national staff are the stable human resource, while the international staff (mostly in management and leadership roles) are rotational, staying only 4–12 months. There are also many vacancies in the international roles due to visa processing difficulties, gender limitations (only female staff were allowed to work in the maternity department) and the COVID-19 pandemic.

Regarding project limitations, patients were not included in the design of this project. Patient and public involvement was deemed to be too challenging given the language and cultural barriers. We did use real patient stories to motivate and engage staff during the simulation training and during case presentations.

On reflection, patient involvement may have been feasible via the Health Promotion Team, who were a team of Yemeni staff members who collected feedback and complaints from patients.

Another study limitation was that we only have numerical audit data for the 3 months when the interventions were studied, and thus long-term sustainment cannot be confirmed.

Our only team member who had prior experience and a formal background in improvement was only present in the project for 4 months. Thus, when she left, team members continued to sustain the improvement initiatives, but were not able to conduct data collection. Subsequent feedback was given to the project only in subjective terms.

Although clinical expertise was of a high level both among our international team and our national team of staff, there was a lack of expertise in education and use of simulation training. The ambition to commence an obstetric drills team training programme did not take off due to the lack of continued expertise in education and simulation training.

CONCLUSION

This project attempted to use improvement methods to improve specific elements of clinical care in this very specific and challenging context.

With regard to our specific aims:

1. We showed a short-term increase in incident reporting through the presence of the International ObGyn and simplification of the reporting process. This increase was not sustained after the International ObGyn left the project.
2. The single multiprofessional obstetric emergency drills simulation was received well with a small increase in self-reported confidence in participants in the key safety behaviours via survey. However due to the lack of expertise and confidence in conducting simulation training, this was unable to continue as an intervention. It is unlikely that the single episode of drills simulation would affect any meaningful long-term culture and communication improvement, but our work showed that this type of educational intervention is fea-

sible and with investment of expertise and time, could be a valued multiprofessional teaching space for action orientated learning.

3. The new drug chart co-designed by staff showed an improvement in drug prescription practices.
4. Fluid restriction in women with severe pre-eclampsia was more reliably carried out following our intervention, but we do not have long-term audit data to confirm sustainment. Subjective reporting from staff 6 months on suggests sustainment of this practice.
5. Blood pressure management was improved over the 3 months of intervention, but we do not have long-term audit data to confirm sustainment. Subjective reporting from staff 6 months on suggests sustainment of this practice.
6. Tranexamic acid usage was increased over the intervention period, indicating that PPH management was probably improved following better identification. We would have needed more data points regarding tranexamic acid consumption in following months to see if the improvement sustained. PPH identification improved over the intervention period, although more data points would be needed to confirm sustainment of improvement.

Our quantitative and qualitative data have shown that broadly speaking, improvement work in this context is feasible and beneficial. In a humanitarian context, the lack of formal risk management and governance structures, as well as an often traumatised and burnout workforce, can mean that improvement work can seem overwhelming. The benefits of using a structured improvement methodology is that the scope of the work can be focused into specific aims, with specific measures that can provide assurance that improvement is happening.

Although there are language and cultural differences, the general principles of engagement, encouraging ownership of the improvement project by the frontline staff and benefits of a coaching leadership style were applicable in this low-income, high-insecurity context. Clear messaging, supportive leadership and staff development would be essential strategies in advancing on this work moving forwards. Expertise is lacking locally in improvement methodology, debrief and facilitation skills and risk management skills including root cause analysis following clinical incidents. Conversely, clinical expertise is reliably present among the national Yemeni ObGyn staff, but they are mostly not given remit for improvement, nor feel empowered. Of course, being in a country currently engaged in an active civil war (with no end in sight), there is a resource implication and instability in the workforce. However, in long-term humanitarian projects such as this one in Taiz Houban MCH (which has been going on for 7 years, since 2015), a robust strategy for the long term in providing resource for improvement expertise, staff support following critical incidents and analysis of these incidents to make robust improvement recommendations is needed.

In conclusion, the lesser heard contexts such as this one, operating in conflict zones around the world, should benefit from attempts to apply basic principles of safety improvement in healthcare. This work is feasible, necessary and as important as in any other healthcare delivery system.

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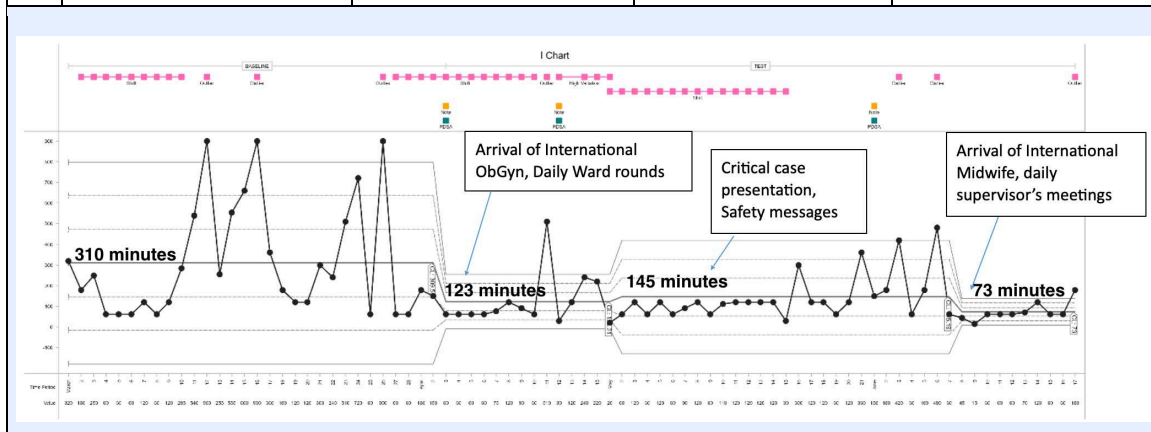
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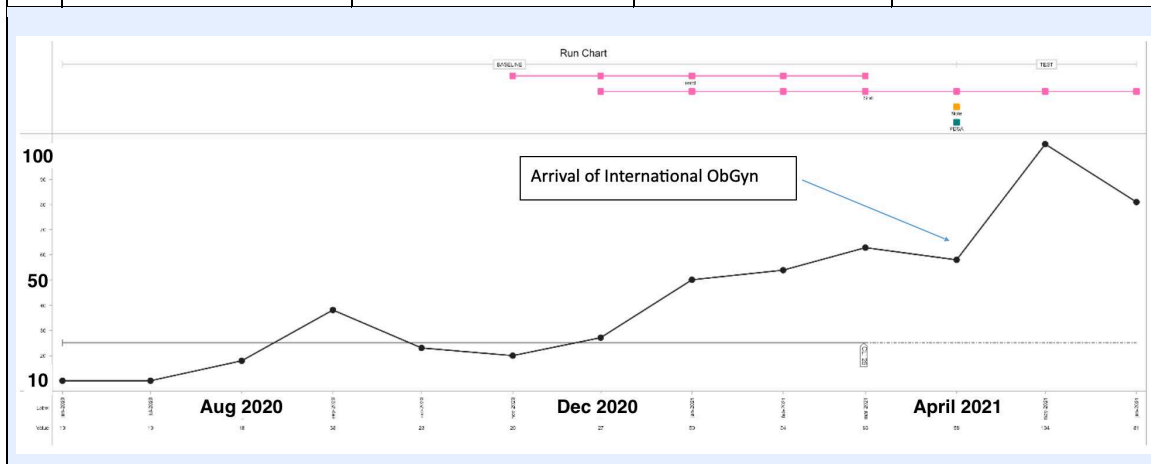
	PLAN	DO	STUDY	ACT
1	Replacing Incident Reporting system with “Quality Reporting” – set of conditions that require reporting (“adverse” outcomes such as maternal hysterectomy, massive obstetric haemorrhage >2.5L, neonatal or intrapartum demise of a baby>2.5kg, maternal intensive care transfer, any other patient care near miss or incident).	Staff found the new form easier to complete. The old incident reporting form required more statement writing by the person reporting the incident and was framed as the action taken when a mistake is made.	Of 7 Quality Reports submitted by staff, 4 were determined to have useful teaching points for the team (fed back through circulars and presentations), and 1 was escalated to the level of a clinical incident. The run chart below shows the monthly incident reporting rate from August 2019-June 2021.	We decided to continue with this initiative but anticipate that creating a culture of reporting of clinical outcomes will take continued reminders and encouragement from management staff. Also, many incidents were reported to management staff verbally.
<p>Run Chart</p> <p>Arrival of International ObGyn, Introduction of Quality Reporting Form for staff</p>				
2.	Daily ward rounds from International Obstetrician and Gynaecologist (ObGyn), 6 th April 2021	Presence of a senior ObGyn meant that the National team was better supported in clinical decision-making for difficult cases and there was more opportunity for discussion and education during ward rounds.	The International ObGyn was able to assess the areas that needed to be prioritized for improvement and use QI expertise to involve staff in this improvement project.	Feedback from national staff was positive, and overwhelmingly that they desired a physical presence from the senior management team and appreciated having a level of clinical accountability in order to improve standards.
3.	Re-design of drug chart – staff opinions about how we could encourage better prescribing and recording of drugs given were sought and a new chart tested. (9 th May 2021)	We found that pre-populated drug doses and frequencies made it easier for these drugs to be recorded accurately when they are given.	Anti-hypertensives were clearly prescribed in 45-75% of charts from March-May 2021. The new chart was introduced on the 9 th May 2021. In June, 100% of antihypertensive prescriptions had dose, timing and frequency documented.	Qualitative feedback from staff was good once they got used to the chart as there was more space to prescribe drugs and the layout decreased risk of errors. We decided to adopt this change.

4.	Re-design of magnesium sulfate chart	We found that though the project had adopted intravenous MgSO ₄ (over intra-muscular) for eclampsia treatment and prophylaxis, the chart monitoring vital signs and fluid management was designed for intra-muscular dosing. There were no fields for oral fluid intake, other IV fluid intake, and temperature. We designed a new chart with these fields included.	The new chart brought to light that the midwives and doctors were not practicing fluid restriction in women with eclampsia and severe pre-eclampsia. Fluid boluses and oral fluids were not clear in the previous chart. This enabled us to do education around fluid restriction. We circulated a local guideline specifying that women should be restricted to 80ml/h total fluids and found adherence improved. From March-May 2021, fluid restriction was carried out in 0%-30% of women. In June 2021, fluid restriction was carried out in 70%.	There as a proposal to replace magnesium sulfate chart with a double-sided vitals and fluid balance chart was taken into consideration but felt that staff were not ready for too many changes in paperwork. This idea was parked. We adopted the new MgSO ₄ chart.
5.	Weekday morning meetings between International Midwife and Maternity Supervisors	The International Midwife arrived on the project on 23 rd May 2021. She was able to have daily feedback to the Maternity Supervisors on key nursing and midwifery management. She also involved the maternity managers in the doctors' ward round.	We were better able to feedback to the midwives regarding escalating vital signs such as hypertension and teaching them how to use the new MgSO ₄ chart and new drug chart in a more effective way.	This daily presence of management staff on the ward was appreciated by the nurses and midwives (from feedback). We decided to continue this as long as the international midwife is present.
6.	Re-design of vitals chart + education regarding use	We realized that the current vitals chart did not have systolic and diastolic blood pressures aligned with the numerical values, causing some confusion amongst staff as to which parameters warrant immediate action. We re-formatted the chart to address this issue.	The new chart was not much different from the old chart in terms of how staff should use it. It took away all ambiguity, placing a systolic blood pressure of 160 and a diastolic of 110 firmly in the Red zone - requiring escalation.	We were not able to use the new chart as the old chart had already been printed with supply for 4 months. We planned to start using the new chart in July 2021.

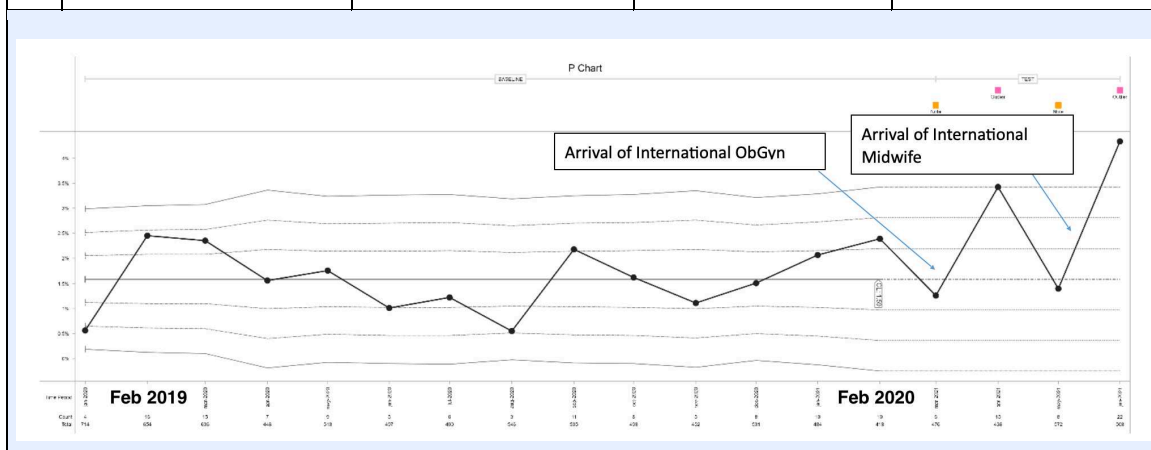
<p>7.</p>	<p>Education campaign regarding acute blood pressure control (23rd April 2021)</p>	<p>We started weekly case presentations and Safety Message of the week circulated via Whatsapp in two languages. We put up printed flowcharts in Arabic and English that displayed a standardized algorithm for acute blood pressure management. See Figure 3 for English version.</p>	<p>See I-chart below for the time taken to control each acute hypertensive episode in successive cases. The baseline mean time to control a hypertensive episode was 310 minutes. This decreased to a mean of 123-145 minutes. After the arrival of the International midwife, who was able to promote recognition and escalation of hypertension amongst the midwives, the mean further decreased to 73 minutes per episode.</p>	<p>These behavioural nudges and reminders were effective in getting midwives to escalate high blood pressure, and doctors to prescribe antihypertensives in a systematic way until the episode is resolved.</p>
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<p>8.</p>	<p>Education campaign regarding PPH management: 1. Pink cannulae were taken away from the maternity and emergency departments and replaced with green cannulae. 2. Weekly case presentations with Emergency Department and Anaesthetic teams. 3. Transfer of patients with an emphasis on SBAR (Situation, Background, Assessment, Recommendation) handover. 4. Tranexamic acid was highlighted as being a first-line drug to use whenever the estimated blood loss is >500ml.</p>	<p>Case presentations led to cross department consensus that it was unacceptable to use pink cannulae (20 gauge) for intravenous access points for maternity patients. SBAR has been promoted as the standard of handover practice that is expected. Presence of International ObGyn on site, who would usually be called for severe PPH cases, meant that use of tranexamic acid could be role modelled. The WOMAN trial (9) was circulated via Whatsapp groups to educate doctors about the underlying evidence base for tranexamic acid in PPH.</p>	<p>We did not collect numerical data on the use of appropriate cannula gauge for maternity patients. We observed that the change in policy of transfer to bedside had resulted in fewer delays resulting from transfer. Simulation training revealed that many staff are still unaware of SBAR but were able to demonstrate effective SBAR handover in simulated scenarios. Case file audit showed that estimated blood loss was only recorded in 40-50% of patients, even with PPH as a diagnosis. Tranexamic acid consumption was already trending upwards in consumption prior to our project but went up further with these behavioural nudges (see run chart below). June consumption may be falsely depressed as there were some days when the department ran out of stock.</p>	<p>Simulation training discussions revealed tension between Emergency Department and Maternity teams but was an opportunity to work together in simulated stressful situations, and SBAR was used effectively by staff. Low levels of PPH identification and low levels of estimated blood loss documentation in case files where PPH is listed as a diagnosis has led us to conclude that PPH is grossly underestimated.</p>
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9.	Midwives and doctors encouraged to carry out routine estimation of blood loss at each birth (13 th June 2021)	Visual estimation of blood loss charts was put up in the Delivery rooms, following a critical case presentation of a PPH case. The International Midwife has been presented to promote and explain the importance of routine estimated blood loss recording.	We studied the effect of this intervention through routinely collected data reflecting PPH identification rates. Through observation on ward rounds, we have found an increase in number of deliveries with routine estimated blood loss documented.	We will continue to add data points as this work is continued by the International Midwife. We hope that in identifying “mild-moderate PPH”, early initiation of first line treatment can occur. Staff have asked if we can obtain graduated collection drapes, and this is being investigated by the team.
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10.	Multi-professional Obstetric Emergency Simulation Drills	We wrote a bank of five scenarios and recruited a multiprofessional team to act as faculty members to run the scenarios, act as the patients, and to give feedback.	We ran two simulation days and took feedback from the first to improve and modify the second. We added a lecture on communication tools such as checklists and SBAR to the start of the second simulation day. Feedback from the simulation days were overwhelmingly positive. We asked participants to rate certain safety behaviors on a Likert scale of 1-5, 5 meaning they were “very confident”. See Appendix 2. The average score from before the training was 4.4 and the average from after the training was 4.6.	Due to the positive feedback and overwhelming feeling from the faculty group that the simulation days were useful exercises for the staff to bond as a team, explore and discuss differences in opinions in a safe space, and to practice SBAR communication, we had aimed to continue this training on a monthly rotational basis. However, when the International ObGyn left in July 2021, there was a vacuum in expertise in simulation training and this intervention was not sustained.
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