

# Implementation of a modified obstetric early warning system to improve the quality of obstetric care in Zimbabwe

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1 **Improving the quality of obstetric care in Zimbabwe through**  
2 **implementation of a modified obstetric early warning system (MOEWS).**

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20

21 **Keywords:** Recognition of deteriorating patients, Maternal Health, Low-  
22 resource settings, Decision support tools, Early Warning Scores.

23 **Word Count:** 2815

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25

26 **Abstract**

27 **Objective:** To implement the Modified Obstetric Early Warning  
28 System(MOEWS) to promote identification and stabilization of unwell women.

29

30 **Methods:** This before and after study of MOEWS implementation took place  
31 between April 2013 and January 2014, in a Government referral hospital in  
32 Zimbabwe. After piloting MOEWS, caesarean section case files were  
33 retrospectively assessed to ascertain pre-operative stabilization. A  
34 longitudinal 'spot-check' study, measured the use of MOEWS and action  
35 taken on abnormal results. A quality indicator was introduced to assess  
36 ongoing implementation. Results were analyzed using chi-squared and  
37 logistic regression techniques.

38

39 **Results:** The caesarean section study included 78 women before and 80 after  
40 MOEWS implementation. There was a significant improvement in pre-  
41 operative stabilization post-intervention(OR 2.78 95% CI 1.39, 5.54). The  
42 longitudinal study included 43 women at baseline and 85 post-  
43 implementation. A significant improvement was recorded in action taken after  
44 MOEWS (1/24(4.17%) vs 28/45(60%) p=0.001). The six-month aggregated  
45 quality indicator revealed 78/125(62%) completed MOEWS, with appropriate  
46 stabilization in 65/70(92.86%).

47

48 **Conclusions:** Implementation of MOEWS improved women's care through  
49 action being taken on abnormal observations. Before whole-scale adoption of

50 MOEWS in low resource settings, this study should be scaled up and

51 repeated to ensure replicable findings.

52

53 **Synopsis**

54 Implementation of a modified obstetric early warning system in Zimbabwe

55 improved action on abnormal observations. This simple system can empower

56 staff and improve care.

57

58 **Introduction**

59

60 Quality of care is gaining increasing attention globally as policymakers,  
61 managers and clinicians acknowledge that improved care can lead to better  
62 outcomes for patients. During the Millennium Development Goals campaign  
63 there was a 47% decline in the number of maternal deaths worldwide, [1]  
64 however this is far short of the 75% decrease which was set as the target for  
65 2015. In trying to meet this goal, several countries in sub-Saharan Africa  
66 introduced policies of removing user-fees for maternity services and,  
67 unsurprisingly, this has increased demand for care.[2]

68

69 In Zimbabwe, maternity services were made free in 2012. This has resulted in  
70 increased demand and therefore staff are under more pressure. In this  
71 environment, simple decision support tools can help staff to identify and then  
72 prioritize unwell patients.

73

74 Tools such as Early Warning Scores (EWS) were developed in order to  
75 facilitate the timely presence of appropriately skilled staff to attend clinically  
76 deteriorating patients.[3] They provide the opportunity to aggregate the impact  
77 of sometimes subtle deterioration in physiological observations into an overall  
78 score which, when abnormal, is used to prompt a clinical response.[4] Many  
79 different EWS systems exist. A recent review of their impact has suggested  
80 that there is a trend towards improved patient outcomes with their use.[4]  
81 However, the unique physiology of pregnant women is not accounted for in  
82 the EWS designed for the general population, and it does not effectively

83 identify at risk patients.[5] Modified Obstetric Early Warning Systems  
84 (MOEWS) have been widely used in the United Kingdom since they were  
85 recommended by the National Confidential Enquiry into Maternal Deaths in  
86 2007.[6] A tool based on similar principals a 'Maternal Early Warning Trigger'  
87 has recently been evaluated in the United States, and has shown a reduction  
88 in maternal morbidity. [7] These tools have not been widely used or evaluated  
89 in resource poor settings.

90

91 The MOEWS charts advocated for in the 2007 Confidential Enquiry[6] are a  
92 simplified EWS, using a color coded method of red and amber scores, rather  
93 than a numerical system. If one physiological observation falls into the 'red'  
94 section of the chart (significantly abnormal) or if two observations are in the  
95 'amber' area (slightly abnormal), a clinical review is required. This system is  
96 less complicated than some of the other maternal trigger systems that have  
97 been developed, [7-9] and therefore was selected for this study as the most  
98 suitable tool for introduction in this low-resource, high pressure setting.

99

100 In 2011 a health-partnership between the Zimbabwean referral hospital and a  
101 UK teaching hospital was initiated. As part of this partnership PRactical  
102 Obstetric Multi-Professional Training (PROMPT) was initiated, and is ongoing.  
103 Alongside this, the Zimbabwean hospital began monitoring their outcomes  
104 using a maternity dashboard.[10] On a background of commitment to quality  
105 improvement, we designed this study to develop and implement a locally  
106 applicable MOEWS to see if patients could be better stabilized before transfer

107 to theatre and if more timely action could be taken when patients began to  
108 deteriorate.

109

## 110 **Materials and Methods**

111 MOEWS was adapted to and piloted in a Zimbabwean Government funded  
112 referral hospital. This hospital had a dedicated maternity unit with  
113 approximately 10,000 deliveries per year and a caesarian section rate of  
114 approximately 18%. The implementation of the adapted MOEWS was  
115 evaluated in three ways. Firstly, an observational before and after study of  
116 whether women were appropriately stabilized prior to transfer to theatre for  
117 caesarean section. The second part was a longitudinal 'spot-check' audit of  
118 use of MOEWS charts on the wards. Finally, there was the development of a  
119 quality indicator for ongoing monitoring of MOEWS use. This study took place  
120 between April 2013 and January 2014. All members of maternity staff had the  
121 opportunity to be included in the piloting process and department wide  
122 implementation was undertaken.

123

124 The first stage of the study, which took place in April 2013, was the adaption  
125 and implementation of the MOEWS chart. The Zimbabwean implementation  
126 team, made up of PROMPT faculty members, was given examples of  
127 MOEWS from the UK. These examples were provided in color and a variety of  
128 black and white designs. The team selected the color version and then  
129 adapted the MOEWS to make it relevant to their local setting, and identified a  
130 local printer. The proposed MOEWS chart was taken to a meeting of the



131 senior nursing staff who agreed on the content of the MOEWS charts and the  
132 implementation plan.

133

134 A piloting phase allowed all members of staff working in the unit to input into  
135 the final version of the charts. Initially charts were given to staff on the wards  
136 for their feedback. Then draft charts were then placed on the wards for staff to  
137 use, with short introductions to the charts given to the staff by the  
138 implementation team. To facilitate the pilot stage, questionnaires were  
139 administered to all available staff on the wards. The questionnaires explored  
140 whether the staff knew what MOEWS were and where to find them. It also  
141 asked if they found them useful and if the trigger system facilitated the review  
142 of patients, there was the opportunity for free text feedback and further  
143 comments. Once further adaptations had been made, the Zimbabwean  
144 implementation team planned a launch event. They also designed a MOEWS  
145 training session to be delivered during the regular PROMPT training course in  
146 order to ensure all staff were familiar with how to use the MOEWS.

147

148 Although the implementation team was composed of PROMPT faculty  
149 members, the intervention was a new addition to PROMPT. PROMPT had  
150 been used by the hospital as a method to deliver onsite annually updated  
151 training to staff since 2011. Due to its regular place in the hospital calendar,  
152 and the fact that all staff were released to attend training annually [10], using  
153 PROMPT as a way to train staff in MOEWS was considered practical by the  
154 MOEWS implementation team.

155

156 In order to measure any immediate change in practice following  
157 implementation of the MOEWS charts, the quasi-experimental before and  
158 after study was undertaken. This examined the effect of MOEWS on the  
159 patients transferred to theatre for a caesarean section. In particular we  
160 examined whether they were appropriately stabilized prior to transfer. Notes  
161 were retrospectively reviewed at baseline (January-March 2013), and at 6  
162 months post intervention (October-November 2013). A convenience sample of  
163 patient notes was used due to resource constraints. For practical reasons,  
164 notes were retrieved by hand from the administrative office and scanned until  
165 patients who had a caesarean section were identified. Data was extracted  
166 onto a proforma by AM and BTM and entered into Microsoft Excel. Descriptive  
167 statistics, Chi-Square tests and logistic regression techniques were used to  
168 understand whether pre-operative stabilization of patients occurred more  
169 frequently after MOEWS implementation.

170

171 The second part of the study was the 'spot-check' audit, designed to enable  
172 quick monitoring of whether ward patients had observation charts, whether  
173 the observations 'trigger' an action according to the MOEWS chart, and  
174 whether there was timely action on abnormal observations. Action was  
175 considered to be taken if the member of clinical staff providing care  
176 documented an action in response to the abnormal observation. This audit  
177 was planned for baseline and then on a monthly basis for 6 months. Data was  
178 collected on a simple form and entered into Microsoft Excel. Descriptive  
179 statistics were calculated to understand the number of women with  
180 observation charts, the number with observations that trigger action and the

181 number of women with action taken across the months. Chi squared tests  
182 were used to compare the baseline group to post-implementation groups in  
183 the follow-up period.

184

185 Following the initial observational study, the implementation team wanted to  
186 look at the longevity of the changes, and embed ongoing evaluation of the  
187 intervention. Therefore the third part of this evaluation, a quality indicator was  
188 developed in order to provide the team with a simple way to monitor the use  
189 of the MOEWS and any ongoing change in practice. This indicator was  
190 measured on a monthly basis from August 2014 until January 2015, by the  
191 MOEWS implementation team. It was carried out when a team member was  
192 able to complete the audit (taking into consideration their clinical workload)  
193 and incorporated the notes of the patients on the ward on that day.

194

195 The quality indicator captured the usage rate of charts (Number of cases with  
196 correctly completed MOEWS charts/Number of cases reviewed), whether  
197 healthcare staff took appropriate action to abnormal observations (Number of  
198 cases in which action was taken/Total number of charts requiring action) and  
199 the timeliness of the action if it is required (Total number where action was  
200 taken within the required timeframe/Total number where action was taken).

201 Simple descriptive statistics were used to allow the implementation team to  
202 assess ongoing use of the MOEWS.

203

204 All analyses were completed using Stata Version 13 (StataCorp, College  
205 Station, Texas, 2013).

206

207 This improvement initiative was approved by the Mpilo Central Hospital  
208 Management and as such no ethical approval was sought. As the intervention  
209 was a department wide change initiative, no individual consent was obtained.

210

## 211 **Results**

212 MOEWS was adapted in April 2013 by the MOEWS implementation team,  
213 then a team of senior midwives at the hospital made further changes and  
214 approved the pilot chart. Changes from the UK example MOEWS included  
215 that they would be used for antenatal admissions, high risk, high dependency  
216 and post-theatre patients only, due to resource constraints. There was a  
217 decision to add 'edema' to the chart as a possible predictor of pre-eclampsia  
218 as urinalysis sticks are not reliably available to measure proteinuria. There  
219 was also an alteration of the 'amber' levels on the blood pressures to bring it  
220 in line with Zimbabwean guidelines. After a discussion about the ability to  
221 measure oxygen saturations, the team decided it should remain on the charts  
222 but they were aware that it was a measure that would not be recorded outside  
223 theatre due to lack of appropriate equipment. They also introduced box for  
224 staff to complete following action on abnormal observations.

225

226 A short pilot of the charts was undertaken and feedback on the charts was  
227 collected and the overall results of the questionnaires staff completed are  
228 displayed in table 1. Reasons midwives found the chart useful included: "most  
229 information compressed and easy to evaluate at a glance" and "they alert the  
230 nurse and alerts us on when to tell the doctor". The midwives on the ward felt

231 a space to record fetal heart rate should be added. Another issue raised by  
232 midwives during this early piloting phase was the need for training “Midwives,  
233 doctors and students in the maternity department could be taught on charting  
234 as some errors are made leading to wrong scoring e.g. recording a systolic  
235 BP and diastolic BP in the same column”. The doctors found that it was useful  
236 to have the “ability to follow a patient in time”. They found the charts “... easy  
237 to correlate with the clinical picture” and that abnormal observations are  
238 “...usually an indicator that action has to be taken or patient has to be  
239 monitored closely”. Like the midwives they felt that “it is a good monitoring tool  
240 if properly followed” and that “everybody should have training in the MOEWS  
241 chart”. The changes suggested from the feedback were made at a final  
242 MOEWS produced for rollout (Supplementary Material S1).

243

244 The caesarean section theatre transfer study included 78 women in the before  
245 and 80 after implementation. There was no difference in the age of the  
246 patients in each group ( $p=0.195$ ). There was a significant increase in the  
247 proportions of patient’s undergoing pre-operative stabilization after the  
248 intervention was introduced (18/79(22.78%) vs 37/85(43.53%)  $p=0.005$ ). Even  
249 after controlling for patient age, participants in the post-intervention group  
250 were more likely to be stabilized prior to caesarean section (OR 2.78 95% CI  
251 1.39, 5.54). There was no difference in operation type, anesthesia delivered,  
252 or estimated blood loss (EBL) or complication rates from caesarean section  
253 between the two groups ( $P>0.050$ ). Demographic and comparison data for the  
254 operating obstetricians were not available.

255

256 In the longitudinal study, there were 43 women in the baseline group and 85  
257 included in the follow-up period. Figure 1 shows the change in action recorded  
258 following the implementation of the MEOWS chart. Before the intervention  
259 there were no formal observation charts and observations were written  
260 directly into the notes. After the intervention, 78/85(91.76%) of patients had  
261 MOEWS charts in their notes and 64/85(75.29%) of the charts were used  
262 appropriately. When dichotomizing the patients into groups before or after the  
263 intervention, there was no difference in the number of women who triggered  
264 the MOEWS score ( $p=0.252$ ), however there was an increase in the  
265 proportion of women that had recorded action taken after implementation  
266 1/24(4.17%) vs 28/45(60%)  $p=0.001$ .

267

268 The quality indicator tool, designed to measure ongoing change in practice,  
269 revealed that in the six month period of its initial use, 78/125(62%) had  
270 completed MOEWS charts. Of these patients action was taken in response to  
271 65/70(92.86%) of patients triggering on the MOEWS chart. All of these  
272 patients received a clinical action within the recommended time frame.

273

## 274 **Discussion**

275 This implementation study has shown that through a partnership approach it  
276 is possible to implement a decision support tool in a Zimbabwean hospital,  
277 which can aid with the recognition of unwell patients and action being taken to  
278 halt their deterioration.

279

280 The success of this study undoubtedly relied on the fact that the adaption of  
281 the MOEWS and the implementation plan were led entirely by the  
282 Zimbabwean team. However, a limitation may be that the exact figures  
283 selected as cut offs in the chart, were not evidence based.

284

285 A further strength is that the Zimbabwean team played an active part in the  
286 ongoing monitoring of the implementation of MOEWS and are continuing to  
287 do this. However, the utility of this quality indicator may be reduced because it  
288 does not incorporate all of the patients on the ward on the day of  
289 measurement, rather a brief snapshot. It is however a pragmatic indicator,  
290 which allows the implementation team to quickly assess the ongoing use of  
291 the MOEWS.

292

293 The fact that this improvement project was undertaken in partnership has  
294 allowed knowledge and skills to be transferred between the UK and  
295 Zimbabwe team. This includes the fact that some of the Zimbabwean  
296 suggestions for the MOEWS charts (e.g. addition of an action taken box) are  
297 also being considered by the clinical team in the UK.

298

299 The training to use the MOEWS charts was embedded within the ongoing  
300 obstetric emergency training programme 'PROMPT'. This does mean that  
301 MOEWS as a stand-alone initiative has not been investigated in this study.  
302 This may bias the findings in this study because the PROMPT training  
303 ensured that there were enthusiastic champions to take the initiative forwards  
304 and also meant that there was an approved and well attended forum for

305 providing the required local training to the maternity team. However, the  
306 training was a stand alone element of the programme and therefore could  
307 feasibly be delivered without the remainder of the PROMPT intervention.

308

309 The implementation of MOEWS was carried out at low cost, which makes it a  
310 feasible intervention to consider implementing more widely. The main cost of  
311 implementing the MOEWS is the printing of the charts, which as it was  
312 arranged locally, in bulk and therefore relatively inexpensive at approximately  
313 0.04 USD per chart. However, even this small cost is likely to be difficult to  
314 meet in the poorest settings.

315

316 As was found in the UK [11] the midwives did not want to use the MOEWS for  
317 every patient, but instead because of limited resources (utilization of charts as  
318 well as time) wanted to use them on a selected group of patients. This limits  
319 the potential of the MOEWS to be a safety net to identify the 'normal' women  
320 who begin to develop complications. This may be the reason that the  
321 simplistic quality indicator performed so poorly with respect to the completion  
322 of charts post intervention as some of the patients in the study may not have  
323 met the basic requirements to be allocated a MOEWS chart.

324

325 A further limitation is that this pilot was undertaken on one maternity ward.  
326 However, it was in a government hospital with 10,000 deliveries per year. If it  
327 is possible to implement the charts at a busy unit like this, it may well be  
328 possible to implement the charts at other units where there are dedicated  
329 maternity staff and a high throughput of patients. Due to time and resource



330 constraints we were unable to investigate whether it is feasible and useful at  
331 smaller centers, where there are no dedicated maternity staff.

332

333 There is a lack of high-quality evidence relating to the MEOWS. The UK  
334 version has been shown to be a useful bedside predictor of maternal  
335 morbidity,[12] however as of yet this tool has not been validated in a low-  
336 resource setting. Therefore, before whole-scale adoption of this decision  
337 support tool in low resource settings, this adapted MOEWS should be  
338 validated and this study should be scaled up and repeated to ensure  
339 replicable findings in other settings.

340

#### 341 **Conflict of Interest**

342 AM, JC and TS are members/trustees of the PROMPT Maternity Foundation,  
343 they have no financial interest in the association. The remaining authors have  
344 no conflict of interest to declare.

345

#### 346 **Authors Contribution**

347 JC conceived the implementation project. AM, BTM, SMO, TS, JC designed  
348 the study. AM, BTM collected the data. AM and SMe analyzed the data. AM  
349 wrote the first draft of the paper and all authors critically revised the draft.

350

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354

356 **References**

- 357 1. World Health Organisation. Trends in Maternal Mortality: 1990-2010.
- 358 2. McKinnon B, Harper S, Kaufman JS, Bergevin Y. Removing user fees  
359 for facility-based delivery services: a difference-in-differences evaluation  
360 from ten sub-Saharan African countries. *Health Policy Plan*. 2014.  
361 doi10.1093/heapol/czu027
- 362 3. Morgan R, Wright MM. In defence of early warning scores. *British*  
363 *Journal of Anaesthesia*. 2007;99(5):747–8.
- 364 4. Alam N, Hobbelink EL, van Tienhoven AJ, van de Ven PM, Jansma EP,  
365 Nanayakkara PWB. The impact of the use of the Early Warning Score  
366 (EWS) on patient outcomes: A systematic review. *Resuscitation*.  
367 European Resuscitation Council, American Heart Association, Inc., and  
368 International Liaison Committee on Resuscitation. 2014;85(5):587–94.
- 369 5. Lappen JR, Keene M, Lore M, Grobman WA, Gossett DR. Existing  
370 models fail to predict sepsis in an obstetric population with intrauterine  
371 infection. *American Journal of obstetrics and Gynecology*. Elsevier;  
372 2010;203(6):573.e1–5.
- 373 6. Lewis G, editor. *The Confidential Enquiry into Maternal and Child*  
374 *Health. Saving Mothers' Lives: reviewing maternal deaths to make*  
375 *motherhood safer - 2003-2005*. London: CEMACH; 2007.
- 376 7. Shields LE, Wiesner S, Klein C, Pelletreau B, Hedriana HL. Use of  
377 Maternal Early Warning Trigger tool reduces maternal morbidity.  
378 *American Journal of obstetrics and Gynecology*. 2016;214(4):527.e1–6.
- 379 8. Hedriana HL, Wiesner S, Downs BG, Pelletreau B, Shields LE. Baseline  
380 assessment of a hospital-specific early warning trigger system for  
381 reducing maternal morbidity *Int J Gynaecol Obstet*. 2016;132(3):337–  
382 41.
- 383 9. Carle C, Alexander P, Columb M, Johal J. Design and internal validation  
384 of an obstetric early warning score: secondary analysis of the Intensive  
385 Care National Audit and Research Centre Case Mix Programme  
386 database. *Anaesthesia*. 2013;68(4):354–67.
- 387 10. Crofts J, Moyo J, Ndebele W, Mhlanga S, Draycott T, Sibanda T.  
388 Adaptation and implementation of local maternity dashboards in a  
389 Zimbabwean hospital to drive clinical improvement. *Bull World Health*  
390 *Organ*. 2013;92(2):146–52.
- 391 11. Mackintosh N, Watson K, Rance S, Sandall J. Value of a modified early  
392 obstetric warning system (MEOWS) in managing maternal

393 complications in the peripartum period: an ethnographic study. *BMJ*  
394 *Quality & Safety*. 2013;23(1):26–34.

395 12. Singh S, McGlennan A, England A, Simons R. A validation study of the  
396 CEMACH recommended modified early obstetric warning system  
397 (MEOWS)\*. *Anaesthesia*. 2011;67(1):12–8.

398 1

399

400

401

402

403 Table 1: Feedback from Midwives and Doctors during the pilot phase.

<b>MOEWS chart:</b>	<b>Midwives(n=15)</b>	<b>Doctors(n=9)</b>
Knowledge of	13(87%)	8(89%)
Location of	14(93%)	7(78%)
Useful	13(87%)	9(100%)
Receive/provide advice/review following trigger	3(20%) always 12(80%) sometimes	4(44%) always 5(56%) sometimes
Suggested improvements	6(40%)	4(44%)

404

405

406 Supplementary material S1: Modified Obstetric Early Warning System

407 (MOEWS) Chart

### MPIO CENTRAL HOSPITAL MODIFIED OBSTETRIC EARLY WARNING CHART

(FOR MATERNITY USE ONLY)

Frequency of observations

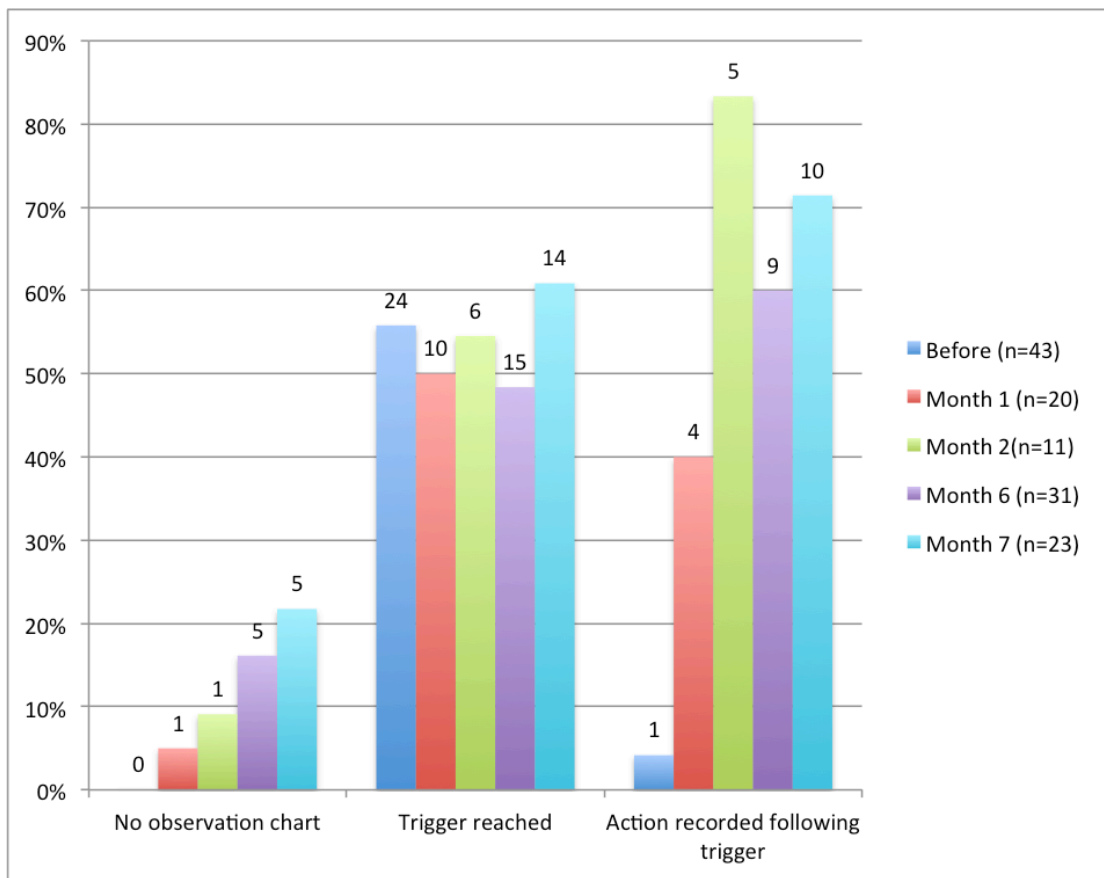
DATE	TIME	FREQUENCY	SIGNED	PRINT	STATUS

Name: \_\_\_\_\_  
 DOB: \_\_\_\_\_  
 Hospital No: \_\_\_\_\_  
 Ward: \_\_\_\_\_

Date: _____ Time: _____												
Respirations (write rate as range box)	>30											>30
	21-30											21-30
	11-20											11-20
	0-10											0-10
Saturations if applicable:	95-100%											95-100%
	<95%											<95%
Temp	40											40
	39											39
	38											38
	37											37
	36											36
	35											35
	Heart rate	170										
160												160
150												150
140												140
130												130
120												120
110												110
100												100
90												90
80												80
70												70
Systolic blood pressure	200											200
	190											190
	180											180
	170											170
	160											160
	150											150
	140											140
	130											130
	120											120
	110											110
	100											100
Diastolic blood pressure	130											130
	120											120
	110											110
	100											100
	90											90
	80											80
	70											70
	60											60
	50											50
	40											40
	Urine Output	> 30mls/hr										
< 30mls/hr or 4hr protein > ++												< 30mls/hr or 4hr protein > ++
Proteinuria	No											No
	protein > ++											protein > ++
Significant Oedema	YES											YES
	NO											NO
Amniotic fluid	Clear (C) Pink (P)											Clear (C) Pink (P)
	Green (G)											Green (G)
Fetal Heart Rate	>160											>160
	110-159											110-159
Neuro response (✓)	<100											<100
	Alert											Alert
	Voice											Voice
PV loss	Plain											Plain
	Unresponsive											Unresponsive
	Normal (N)											Normal (N)
Looks unwell	Normal (N)											Normal (N)
	Mild (M) Severe (S)											Mild (M) Severe (S)
	Offensive (O)											Offensive (O)
Total Amber Scores	NO											NO
	YES											YES
Total Red Scores												
Action Taken Yes / No												
Action or reason for no action												

CONTACT DOCTOR FOR EARLY INTERVENTION IF PATIENT TRIGGERS ONE RED OR TWO AMBER SCORES AT ANY ONE TIME

409 Figure 1: Graph to show the utilization and action on the MOEWS charts over  
410 time.



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