QUALITY ASSURANCE PROJECT

Improving the Management of Obstetric Emergencies in Uganda through Case Management Maps

Barbara Kerstiëns, Agel Akii, Nazarius Mbona,
Abby Zziwwa, and Wendy Newcomer Edson

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University Research Co., LLC • 7200 Wisconsin Avenue, Suite 600 • Bethesda, MD 20814 • USA • www.qaproject.org

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TEL (301) 654-8338
FAX (301) 941-8427
www.qaproject.org

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Abstract

In this study, Uganda's Jinja Hospital and the Quality Assurance Project developed and implemented case management maps (CMMs) for two distinct pregnancy-related conditions: pregnancy-induced hypertensive disorders (PIHD) and postpartum hemorrhage (PPH). CMMs are pre-printed forms that serve as job aids to help prompt members of the healthcare team to perform required tasks. At Jinja the tasks on the CMM for PIHD reflected a new protocol of care that hospital staff and management had adopted as part of the development of the CMM. Jinja's CMMs list down the left side of a sheet of paper the tasks providers must accomplish for a particular condition, and they list across the top a timeline (e.g., hourly, daily) when the tasks must be accomplished.

The study measured adherence to three care standards and patient outcomes for both intervention conditions during the 12 months before the introduction of each CMM and during the 12 months afterward. The care standards for PIHD were proteinuria on admission, blood pressure three times daily, and propanolol on admission; for PPH they were hemoglobin test on admission, complete blood count daily, and iron and folic acid daily. The sample sizes for PIHD were 36 cases before and 50 after; for PPH they were 20 cases before and 10 after.

Before and after measurements were also obtained for a comparison (control) condition, acute pelvic inflammatory disease (PID), for which no CMM was developed. PID was chosen as

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Case management maps (CMMs) are about teamwork: Congratulations to the members of the two CMM development teams. This study was also about teamwork, so the first author would like to express her appreciation to all the authors for their unfailing dedication to that approach, and especially to Dr. Agel Akii for his collaboration and leadership and to Nazarius Mbona for his dedication and skills.

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List of Abbreviations

BP	Blood pressure
CBC	Complete blood count
CMM	Case management map
Hb	Hemoglobin
$MgSO_4$	Magnesium sulfate
NA	Not applicable
OPD	Outpatient department
PIHD	Pregnancy-induced hypertensive disorder
PID	Pelvic inflammatory disease
PPH	Postpartum hemorrhage
QAP	Quality Assurance Project
RR	Relative risk
SD	Standard deviation
Temp	Temperature taken
USAID	US Agency for International Development
WHO	World Health Organization

I. Introduction

A case management map (CMM) is a type of critical pathway that informs healthcare workers what to do and when to do it for a specific diagnosis. Critical pathways were introduced in U.S. hospitals in 1991 to reduce costs by streamlining care and improving the efficiency of care given by multiple professionals in a hospital (Coffey et al. 1992). They define the optimal sequencing and timing of interventions by physicians, nurses, and other staff for a particular diagnosis in order to improve resource use, maximize the quality of care, and minimize delays. Critical pathways are commonly used in U.S. hospitals but not in hospitals in developing countries. Other terms for critical pathway include critical paths, Care Maps®, and care pathways.

Thus, CMMs are a type of job aid for healthcare workers. Other types of job aids for healthcare workers are counseling cards, reminder cards, and clinical algorithms (Edson et al. 2002; Edson et al. 2003; Edward-Raj and Phiri 2002; Tavrow et al. 2002). Job aids have been shown to improve healthcare provider performance according to standards (Knebel et al. 2000; Lahie et al. 2001), but job aids alone do not ensure high performance. Also needed are competent and motivated providers and a healthcare system that supports and rewards good performance. Job aids work best as a memory aide when performance can be enhanced by improving either skill or knowledge. Job aids used in training can decrease training time. A job aid may be useful if a task is complex and performed infrequently and there are severe consequences if the job is not done right. Barriers to the use of job aids are a lack of time to refer to one and social/cultural issues that may affect credibility and trust in a client/provider relationship.

The CMMs developed for this study relate to two conditions that may result from pregnancy: pregnancy-induced hypertensive disorder (PIHD) and postpartum hemorrhage (PPH). These CMMs can function as a job aid, a medical record, and/or a teaching aid. In addition to sequencing various interventions, they provide spaces where providers should record the results of tests (such as blood pressure), the time the test was taken, and their initials. Care is documented on a grid with the rows containing care activities (e.g., monitoring, treatment, medication, diet, patient counseling) and the columns indicating time (e.g., hour, day, month). The timeline for activities is not as specific as it is for pathways used in developed countries, where some information on intermediate and end outcomes is annotated on the pathway.

II. Background

Maternal mortality is perhaps the most important cause of loss of healthy life years in Uganda, a cause that could be readily reduced through improved quality of care. One of the reasons why the maternal mortality rate is still appallingly high is the poor performance according to standards of essential obstetric care once women arrive at a hospital. At the 500-bed Jinja Hospital in 1998, there were 3,919 deliveries and 30 maternal deaths. More than half of those deaths were likely preventable with better management of obstetric complications such as pre-eclampsia, hemorrhage, and sepsis both at the health center and hospital levels. During that year, 57 patients were admitted with pre-eclampsia, of whom five died. Pre-eclampsia is a serious complication of pregnancy or delivery that, if ineffectively treated, can lead to eclampsia and death. Management of pre-eclampsia requires that many interdependent services be provided to the patient. If they are not appropriately coordinated and scheduled, the quality of care decreases with the possibility of fatal outcome for either the mother or newborn.

The Ministry of Health in Uganda asked the Quality Assurance Project (QAP) to assist in developing, implementing, and evaluating CMMs at Jinja Hospital for the management of PIHD[1] and PPH,[2] in order to improve the quality of care for these conditions.

The objectives of the study were twofold:

- To develop, introduce, and use CMMs for management of obstetric complications, specifically PIHD and PPH.
- To measure the effect of the use of the CMMs on compliance with standards, patient outcome, resource use, and provider satisfaction.

Principal investigator Barbara Kerstiëns, MD, MPH, led the study and undertook this work for QAP as a consultant to The Johns Hopkins University School of Hygiene and Public Health, then a QAP partner. A multi-disciplinary team of hospital staff developed the CMMs, working largely on their own under the leadership of co-principal investigator Dr. Agel Akii, an obstetrics/gynecology specialist consultant, and with guidance from the non-resident principal investigator. Medical Statistician Nazarius Mbona conducted the data analysis, and Medical Anthropologist Dr. Abby Zziwwa conducted the qualitative study on provider satisfaction.

The strategy to develop and implement job aids was based on the principal investigator's personal experience, Mozena and Black (1996), and elements from the quality design of health services methodology developed by QAP.

The CMM development process had four phases, each with two or more steps, as outlined in Table 1 and detailed in Section III.

III. The Interventions

Each intervention had six parts: (1) developing of a case management map, (2) training in how to use the map, (3) introduction and use of the map, (4) acquisition of missing supplies and equipment needed to treat patients in accordance with the treatment protocol, (5) defining and monitoring indicators to measure the effect of the CMM, and (6) revising the CMM to improve it based on experience.

The intervention was applied to two potentially fatal conditions: pregnancy-induced hypertensive disorder (PIHD), including pre-eclampsia, and postpartum hemorrhage (PPH). The protocol for PIHD had to be updated, adding another activity to the six listed above. The timing for implementation of the activities was sequential, with the PIHD-related activities beginning six months before the PPH-related activities. This enabled healthcare managers to introduce changes on the ward progressively and with control over the development and introduction process. A record review was conducted in August of 1998 to collect baseline information on the treatment of PIHD, PPH, and sepsis (postabortion, postpartum, and post-caesarean section). In September 1999, the standards of care were communicated for the three conditions. We introduced the standards for PIHD via the CMM. We introduced standards for the other two conditions through a staff meeting and the distribution of the

[1] Pregnancy-induced hypertensive disorders (PIHDs) manifest as high blood pressure and other symptoms. PIHD can cause pre-eclampsia, which can lead to eclampsia, convulsions, and maternal death. Pre-eclampsia is usually the admitting diagnosis. This paper sometimes uses "PIHD" for convenience (and especially for brevity in the tables and figures) where "pre-eclampsia" may be the technically correct term.

[2] Postpartum hemorrhage (PPH) is excessive vaginal bleeding that can occur after giving birth or having an abortion. Potentially fatal to the mother, it has four main causes: uterine atony, retained placenta, lacerations of cervix/uterus, and coagulation defects.

Table 1
CMM Development Process

Phase 1: Defining the Project	
Step 1: Select the diagnosis	The principal and co-principal investigators selected a diagnosis.
Step 2: Select the team	
Step 3:Define the scope of the case management map	The multi-disciplinary team defined the scope of the CMM for each diagnosis.
Phase 2: Developing the CMM	
Step 1: Describe the current case management process	The team analyzed the existing case management process at Jinja.
Step 2: Define CMM format	The team decided on the purpose and elements of the CMM and designed its format. For PIHD the team decided to adapt the national Uganda PIHD case management guidelines and Safe Motherhood guidelines as the basis for the CMM, a challenging task that involved the entire team.
Step 3: Develop a draft CMM	
Step 4: Define indicators for monitoring and identify person(s) responsible for collecting data	
Phase 3: Implementation	
Step 1: Prepare for implementation	A two-day training session was held for the staff. This process was undertaken twice: from April to June 1999 for the CMM for PIHD, and between November 1999 and February 2000 for the CMM for PPH.
Step 2: Implement	
Phase 4: Monitoring and Evaluation	
Step 1: Monitor	The study team developed a monitoring plan and study protocol for assessing the impact of the CMMs on compliance with standards, patient outcomes, resource use, and provider satisfaction. Data were collected until September 2000.
Step 2: Problem solve	

written clinical protocol. Figure 1 shows the timeline.

A. Planning and Implementing the First Intervention

The principal investigator developed a methodology to guide the project leaders in implementing the study. The methodology mapped the steps (and their expected results) that would allow a multidisciplinary team to fully implement the intervention in accordance with the six activities.

This section describes the experience in developing the CMM for PIHD. It follows the four-phase CMM methodology developed by the principal investigator and outlined in the Background Section. Section B, below, sketches the same process for PPH, noting only the informative differences between the two experiences.

Phase I: Defining the Project

In defining the project, the principal and co-principal investigators collaborated with the head nurse on three steps that defined and started the project.

Step 1: Select the diagnosis. Developing a CMM requires selecting a condition on the basis of certain criteria. First, it should be high risk, high volume, or problem prone. Second, case management has to be possible. Third, the treatment should involve more than two staff.

Risk. Working with Head Maternity Nurse Sister Babyerabira, the principal and co-principal investiga-

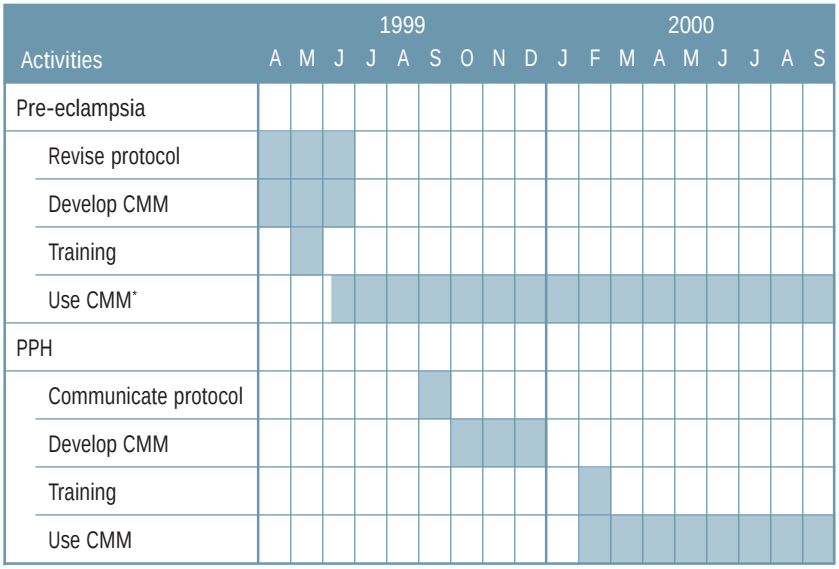
tors began the process of selecting a condition, aware that a high-risk obstetric complication would be selected. The World Health Organization (WHO) and others recognize PIHD, PPH, and sepsis as leading causes of death among obstetric complications. Jinja's files did not provide much information on the risk of these conditions specific to the hospital: 32 deaths were recorded in 1997, but only 10 files were found. Of those 10 cases, one woman died of eclampsia, three of PPH, and three of sepsis. The paucity of statistics provided little reliable information on the relative risk at Jinja among these three conditions.

Volume. Volume was nearly equal for all three conditions. The record review of 1997 files found 51 cases of PIHD, 41 cases of hemorrhage occurring after abortion or giving birth, and 51 of sepsis resulting from abortion or giving birth.

Problem proneness. Although CMMs are most beneficial when used for conditions that are prone to problems if not managed correctly, an excess of problems can inhibit a CMM's success, especially a hospital's first CMM. Thus, even though Dr. Agel Akii and Sister Babyerabira thought a CMM could help overcome care problems related to PHID and PPH, they were concerned that even with a CMM, staff might not be able to overcome the PPH-related problems. Part of the concern was that the treatment of PPH often requires blood transfusion, but blood is frequently lacking. They felt that it would be better to have staff begin with a CMM for a treatment that they could fully provide.

Possibility of case management. Some treatments are so complicated that it is unlikely that a CMM could be created that would describe the appropriate treatment clearly, or treatments can be so simple that a CMM adds nothing. Neither was the case with PIHD or PPH. It was thought that management of both conditions could benefit from a CMM.

Figure 1
Timeline for Implementing Activities for the PIHD and PPH Interventions



* Use started 6/10/99; final US-printed CMMs arrived in October 1999.

Two or more staff. All three conditions under consideration involve more than two staff.

Pre-eclampsia was selected as the first illness for which a CMM would be developed. The case definition was "Any woman presenting with a blood pressure of 140/90 mm Hg or more and/or signs of proteinuria, headache, and dizziness." (WHO 1997) We discussed our plan with co-operating agencies (Safe Motherhood, UNICEF, and JHPIEGO) for their advice on our decisions thus far and confirmed that we were proceeding in the correct direction.

Step 2: Select the team. Selecting the team that would implement the CMM resulted in representation of the professionals involved in the management of pre-eclampsia: an obstetrical/gynecology specialist, a medical officer, the head nurse and deputy head nurse in maternity, two intern doctors, a pharmacist, and a senior laboratory technician. Representation of all professionals involved in the process of care is not always possible but is thought to be ideal.

Step 3: Define the scope of the case management map. Defining the scope of the CMM meant determining when treatment in accordance with the CMM would begin and end, what activities would be included, and which areas of

treatment would be addressed. We decided to focus on the management of suspected pre-eclampsia and PIHD from admission to discharge.

Phase 2: Developing the CMM

Phases 2 through 4 were performed by the implementation team, led by the co-principal investigator with the advice and guidance of the principal investigator. In this phase, the study team participated in meetings, gathered and analyzed information between meetings, and made decisions to put the words and graphics for the CMM on paper, making it ready for actual use, although in draft form. The co-principal investigator and colleagues undertook four steps to bring implementation to the point of introducing the CMM on the ward.

Step 1: Describe the current case management process. The team developed a description of the current process of management by recording the elements that were then part of management for pre-eclampsia. These elements included the individual or team that performed each activity, the system for recording activities, and problems being encountered in managing pre-eclampsia. Treatment activities included consultations, monitoring, tests, treatments, medications, diet, physical activity, and patient and family education. The system for recording activities indicated what information should be recorded in the patient file, what documents should be stored in the patient file, and what should be recorded in other data collection systems. Next, the team brainstormed (e.g., aired opinions about what happened and when under the then-current treatment) and flowcharted the then-current process.

Step 2: Define CMM format. Defining the format was challenging for Jinja staff because they were unfamiliar with CMMs. This information gap was bridged by presenting a table similar to Table 2. This presentation helped the team conceptualize what their CMM would look like. Note that activities are listed down the left-hand side of the page and that time proceeds from the left side to the right. The team decided that the map should fit in the patient file and that the paper should (a) be thick so as not to tear easily and (b) be two different colors—one for the first page and another for subsequent pages.

Step 3: Develop a draft CMM. Developing a draft CMM involved deciding what text should appear on the page, which cells in the table should be used for staff notation, etc. The team developed a clinical protocol for the management of pre-eclampsia, using as resources the draft national guideline on the management of hypertensive disorders during pregnancy, international guidelines from Safe Motherhood, and benchmarking.[3]

The team used the new protocol to develop a list of activities to be performed daily. The list specified monitoring, tests, medications, etc., and indicated who, by cadre, would be responsible for each activity. The protocol did not fully define all the activities and the frequency of all the activities that had to be undertaken as part of treatment, so the team engaged in discussion about what should be done in areas where the protocol was not fully suitable. For instance, the protocol indicated that blood pressure (BP) should be taken

Table 2
Example of a CMM Format Presented to Jinja Staff

Condition:				
	Timeline			
Activities	Day 1	Day 2	Day 3	Day 4
Consultations				
Assessment				
Treatment				
Medication				
Diet				
Activity				
Counseling				

[3] Benchmarking is a means to improve a product, process, service, etc.; it involves identifying successful examples from another setting(s) and adapting the elements of those examples to the setting being improved. In this case, the principal investigator consulted experts in the use of CMMs at The Johns Hopkins Hospital in Baltimore, MD.

hourly, which was not feasible at Jinja. To balance the desirable and the feasible, the team agreed that BP should be taken three times a day. A second example relates to the urine protein test, normally done by the laboratory. The team, which included the senior laboratory technician, decided to teach selected staff members to conduct these tests.

The team was careful to make the CMM as easy to follow as possible. For instance, they decided that not only would BP be taken thrice daily, but also that this activity would occur with the change of shift and at the same time that the fetal heart rate was assessed. This plan complemented the CMM in reminding staff of the timing of their responsibilities. The team also discussed problems related to drug stock-outs, broken equipment, and other issues that were resolved later and are discussed below.

The team identified critical events, which are the signs and symptoms that occur over the course of an illness that call for a change in diagnosis and/or therapy. For instance, convulsions (progression to eclampsia) are a critical event for pre-eclampsia (and other illnesses) because they cause high risk to the patient. The team identified convulsions as a critical event and three others: blood pressure not lowering after two days of treatment, fetal heart rate either increasing or decreasing, and newborn not breastfed. For each type of critical event, the team outlined how the condition should be managed in such event. The team developed the draft CMM and an accompanying instruction sheet,[4] which complement each other to remind staff which actions must be taken and when, providing extra detail on critical events. Lastly, the team decided that the pre-eclampsia CMM should include a problem list; patient outcomes; and discharge information, such as the follow-up appointment.

At this point, the draft CMM for pre-eclampsia looked similar to the final version (presented in Appendix A, the instruction sheet is in Appendix B). The final was 11" x 17.5" (folded to 8.5" x 11" to fit in a file folder) and on heavy, colored paper. It also differs slightly from the draft in both text and graphics because of changes made after a brief trial period.

Step 4: Define indicators for monitoring and identify person(s) responsible for collecting data. Indicators would show whether the CMM was effective in improving staff performance to standards and patient outcomes and whether the staff were effective in implementing the CMM. The team limited the number of indicators so that recording and collecting data would not be burdensome, and they were careful to select indictors that could be monitored over a sustained period. The four staff performance indicators were:

- For assessment, proteinuria test on admission;
- For monitoring, blood pressure measured three times per day;
- For treatment, propanolol prescribed on admission, given twice a day for at least two days;
- For critical event management, magnesium sulfate ($MgSO_4$)[5] given in the event of convulsion.

They also identified five other indicators that were intended to complement the staff performance indicators and measure the overall use and impact of the CMM. Three applied to both PIHD and PPH and two applied to PIHD only:

- Percentage of CMMs correctly completed (all CMMs),
- Number of times per month when propanolol and $MgSO_4$ were out of stock (PIHD only),
- Percentage of patients admitted for pre-eclampsia who progressed to eclampsia (PIHD only),
- Percentage of staff who know how to use the CMM (all CMMs), and
- Case fatality rate (all CMMs).

For these five indicators the team identified a data source, frequency

[4] Written in a reader-friendly tone, the instruction sheet reminds staff why using the CMM is beneficial, how to use it, and how to treat pre-eclampsia. It opens with a definition of pre-eclampsia and then states, “This Case Management Map (CMM) is designed to help you manage a patient with pre-eclampsia. To manage a patient well, we need to know several things, we need to monitor several things, and we need to write this down so others can know what the patient’s situation is, what has been done and can help us manage the patient.” The instruction sheet then reminds staff to perform certain activities, such as requesting the patient’s name upon admission, checking BP thrice daily, and monitoring for convulsions and indicating on the CMM whether convulsions occurred.

[5] $MgSO_4$ is used to treat pre-eclamptic patients who have a convulsion, a life-threatening event that, among other things, signals that a pre-eclamptic patient is becoming eclamptic, or critically ill. Diazepam was Uganda’s first-choice drug for convulsions at the time of the study, but our benchmarking had revealed that $MgSO_4$ would be more effective.

Table 3
Monitoring Indicators for CMM for PIHD

Indicator	Source of Data	Frequency of Collection	Person Responsible
Indicators to monitor continuously			
Percentage of CMMs correctly completed	CMMs	Every 2 weeks for the first two months; monthly thereafter	Case manager
Number of times a month when propanolol and $MgSO_4$ were out of stock	Pharmacy stock cards	Monthly	Pharmacist
Percentage of patients admitted for pre-eclampsia who progressed to eclampsia	CMM	Monthly	Medical officer
Indicator to monitor initially only			Co-principal investigator or case manager
Percentage of staff who know how to use the CMM	Interview initially; later retrospectively review CMMs	Weekly	
Indicator to monitor later			
Case fatality rate from PIHD	CMM	Semi-annually	Co-principal investigator and the medical officer

of collection, and person responsible. Table 3 shows these indicators, sorted according to the monitoring timing.

Phase 3: Implementation

The third phase of the planned methodology had two steps: Prepare for implementation and the implementation itself. During this phase, staff who had not yet learned of the CMM would not only become familiar with it, but also begin to work with it.

Step 1: Prepare for Implementation. The team developed an implementation plan. They identified major changes linked with the adoption of the CMM and the staff, by cadre, who would be affected by the change. For example, physicians would be affected by standardization of the types of drugs to be used, and midwives would be affected by having to measure proteinuria in newly admitted PIHD patients and take their BP thrice daily.

During a staff meeting, the principal investigator explained the rationale for using a CMM. A two-day training in both the new protocol for pre-eclampsia and using the CMM was presented in May 1999. This was also the time to ensure that the necessary resources were available to follow the protocol. Propanolol (Inderal®, Aldomet®) was recommended to replace alpha-methyl-dopa to be given at admission and thereafter to control BP. Adequate supplies of propanolol had to be assured. We recognized that $MgSO_4$ and blood pressure cuffs were not in place and had to find ways to acquire them. Jinja received a donation of $MgSO_4$, temporarily solving the problem and allowing the study to proceed without $MgSO_4$ procurement difficulties. When the national guideline on PIHD was subsequently revised to allow for the use of $MgSO_4$ in treating eclampsia, this drug became more readily available.

We also needed blood pressure cuffs and, finding no other way to acquire them, the co-principal investigator purchased them with personal funds.

Step 2: Implement. The CMM, still in draft format, was introduced on the maternity ward on June 10, 1999. It required several major changes to existing hospital practices, including standardizing drugs, close monitoring of maternal blood pressure, testing urine protein on the ward, and recording of and initialling actions taken. Some staff were resistant to the changes; their concerns were presented at the staff and problem-solving meetings described in Phase 4.

Phase 4: Monitoring and Evaluation

In this two-step phase, the implementation team set in motion the plan to determine whether their efforts proved effective.

Step 1: Monitoring. Sister Babyerabira supervised and helped staff in using the CMM correctly. She thought about ways the CMM could be changed to make treating pre-eclampsia easier, and she recorded the number of CMMs used and the number correctly filled out.

Step 2: Problem solving. Problem solving began after a month of CMM use at a staff meeting where users discussed the CMM experience. The usage indicator showed that some staff did not sign off on their tasks. Two measures were taken to address this shortcoming. First, staff were reminded why this step is important in treating and monitoring each patient. Second, the CMM format was redesigned to make signing off easier.

Another problem was that the physicians were not performing the hyperreflexia test—called for by the new protocol. This matter was addressed through a redesign of the CMM. We also redesigned the instruction sheet to correct performance errors discussed at staff meetings.

B. Planning and Implementing the Second CMM

This section describes the development of the CMM for PPH and focuses on differences from the experience of the first CMM. One major difference was that Dr. Agel Akii and other staff managed the development and implementation of the second CMM largely on their own. Another was that progress proceeded much more quickly since staff was familiar with the concept of a CMM and the processes involved in developing and implementing one. While the first development process was quite formal, carefully following each step in order, the second was less so. The second CMM was developed during four meetings, whereas the first took six. To start, we reviewed our notes on what had happened the first time and contemplated what would be different, what we should do differently, and similar concepts.

Phase 1: Defining the Project

Step 1: Select the diagnosis. Our earlier discussions had led us to believe that PPH should be the second condition treated with a CMM. Though not high volume, it was even more high risk than pre-eclampsia and more problem prone because of the frequent shortage of blood. It did prove more difficult to map, as discussed below, but doing so appeared feasible. Lastly, PPH requires more than two people for treating patients. The standards of care were communicated for PPH during a staff meeting in September 1999. The case definition was “Any woman presenting after delivery with vaginal bleeding of 500 ml. or less than 500 ml. if signs of deterioration of general status are present.” (WHO 1997)

Step 2: Select the team. The PPH implementation team was similar to the pre-eclampsia team except that a different medical officer participated, the pharmacist was not included because drug supply is not a difficulty in treating PPH, and three interns were added to the team.

Step 3: Define the scope of the CMM. Admission and discharge were again selected as the start and end points of the treatment.

Phase 2: Developing the CMM

Phase 2 required three meetings.

Step 1: Describe the current management process. At one meeting, the team discussed the scope of the CMM and flowcharted the current management process.

Step 2: Define the CMM format. CMM format and content were topics of the next meeting. At this point, the team reached its greatest diversion from its previous experience. They faced the problem that PPH has four main causes (uterine atony, retained placenta, lacerations of cervix/uterus, and coagulation defects), whose treatments could not all fit on one sheet of paper (even 11" x 17.5"). They decided to divide the map into three sections: admission, treatment, and discharge. They standardized the first and third sections (admission and discharge) on the CMM and precisely described treatment for each of the four causes in the second section. Each treatment was printed on separate sheets that could be selected on the basis of the cause presenting, and then that sheet would be attached to the patient’s CMM.

Step 3: Develop CMM. The second CMM was drafted; it looks much like the first: large, heavy paper; different colors for the first page and subsequent pages, and table format with activities down the left and time proceeding from left to right across the top. The biggest difference is that it has a longer instruction sheet.

Step 4: Define the indicators for monitoring and person(s) responsible for collecting data. The team defined four indicators of staff performance to standard for PPH:

- For assessment, hemoglobin test on admission;

- For monitoring, vaginal blood loss checked daily;
- For treatment, iron and folic acid (or Inferon®) prescribed during stay;
- For critical event management, transfusion given (or prescribed) in case of Hb<5g/l or shock.

Four other indicators were used to measure overall use and impact of the PPH CMM (shown in Table 3). Of the four, three applied equally to all obstetric complications, and one was specifically related to PPH. They were:

- Percentage of CMM correctly completed (all CMMs);
- Times per month when iron and folic acid (or Inferon®) are out of stock (PPH only);
- Percentage of staff who know how to use the CMM (all CMMs); and
- Case fatality rate (all CMMs).

Phase 3: Implementation

Step 1: Prepare implementation of CMM. The team prepared a two-day training workshop for the second CMM, and team members learned in a fourth meeting how to participate as facilitators during the workshop. Plans were made to ensure that needed supplies and medications would be available, including iron and folic acid, X-pen Gentramycin, Amoxicillin, and Metronidazole. During training, the instruction sheet was used to highlight changes in the treatment protocol. Training again included small groups practicing completing the CMM.

Step 2: Implement CMM. The CMM was implemented in February 2000, shortly after training and three months after the development process began.

Phase 4: Monitoring and Evaluation

Step 1: Monitoring. The CMM team met weekly after implementation, inviting a few people from the staff, to discuss problems in implementation.

Step 2: Problem solving. One month after implementation, a general meeting was held with the team members and all staff to assess progress and problems. A problem-solving session was held, and feedback from the indicators was given to the staff.

IV. Evaluation Methodology

A. Research Design

Each study objective had its own study design. A descriptive method was used to document the methodology of developing and implementing a CMM. A quasi-experimental (before/after) design and a descriptive design were used to measure the effect of the CMM use on performance according to standards, patient outcome, resource use, and provider satisfaction. The documentation method was used to demonstrate that the effects on patient outcome and resource use are dependent on compliance with standards. The expectations were that performance according to standards of clinical care would improve, case fatality rate would decrease, average length of stay would decrease, and providers' attitudes and perspectives would change. We thought the different length of use for each CMM (eight months for PPH versus 12 for PIHD) might also result in different effects on performance to standards.

A simple before/after study was deemed insufficient to test the intervention and adequately demonstrate the effect of the use of a CMM: Contamination was an issue, as PIHD and PPH were managed on the same ward. That is, staff who had worked with the CMM for PIHD might show an increased performance in managing PPH, an increase not creditable to the PPH map. To address this, we decided to have a control group of patients admitted to the gynecological ward who also had a serious condition. Our rationale was that the nursing staff was different, avoiding contamination. The head of the ward was the co-principal investigator of this study, which was advantageous: Since the same person communicated standards to both groups, consistent communication across all three conditions was ensured. The control group consisted of patients with acute pelvic inflammatory disease (PID). Their records were abstracted for performance according to standards.

B. Study Sample

The study sample comprised all patients hospitalized with PIHD or PPH in the maternity ward and all patients with PID in the gynecological ward. Inclusion criteria were defined as:

PIHD: "Any woman pregnant, in labor or having recently delivered, presenting with or developing a BP of 140/90 or more and/or edema, signs of proteinuria, headache, dizziness but without convulsions" (WHO 1997).

PPH: "Any woman presenting with vaginal bleeding of 500 ml. or less than 500 ml. if signs of deterioration of general status, after delivery" (WHO 1997).

Acute PID: "Any woman presenting with low abdominal pain, vaginal discharge, tenderness or guarding at pelvic examination and fever (38.5 C)" (Holmes et al. 1990).

Patients admitted for the above-mentioned conditions from June 15, 1998, to June 14, 1999 (12 months before the introduction of the pre-eclampsia CMM), and from September 15, 1999, to September 14, 2000 (12 months after the introduction of the first CMM), were included in the study. The period June 15, 1999, to September 14, 1999, was a transition period during which the pre-eclampsia CMM was being introduced.

C. Process and Outcome Indicators

We measured four categories of indicators: performance according to standards, patient outcomes, resource use, and provider attitudes and perspectives.

Performance according to standards. The management of each condition differs, so designing a way to compare performance across conditions was challenging. For each condition, we identified "key tasks" that, if not performed according to standard, would compromise the clinical decision-making process and sound case management. The criteria used to select tasks were: similar types of staff (e.g., nurses, physicians, lab technicians) were involved in the performance of the selected tasks, and each selected task had to require about the same amount of work. Four key tasks were selected for each condition (Table 4).[6] Three relate to normal management. We chose one task from each of three categories: assessment, patient monitoring, and treatment. The fourth task related to the management of a critical event during hospitalization.

Patient outcomes. Case fatality rate was the main indicator of patient outcome. For PIHD, we also included neonatal outcome (proportion of stillbirths) and the percentage of women progressing from pre-eclampsia to eclampsia.

Resource use. Resource use was measured by length of hospital stay.

Provider attitudes and perspectives. Provider attitudes and perspectives toward CMM use were assessed with a qualitative survey administered to doctors, midwives, and senior nursing officers. The survey assessed the ease or difficulty providers had in using the CMM; perceived effects of the CMM on providers, including changes in communication among them; and provider satisfaction with the CMM.

D. Data Collection Instruments and Procedures

A tool was developed to abstract recorded data on process and outcome indicators from a retrospective review of medical records for the three diagnoses. The tool was used to collect data on provider perfor-

Table 4
Key Tasks for Each Obstetric Condition

Type of Management	Function	PIHD	PPH	Acute PID
Normal management	Assessment	Proteinuria test on admission	Hemoglobin (Hb) test on admission	Complete blood count (CBC) on admission
	Monitoring	Blood pressure measured three times a day	Vaginal blood loss checked daily	Temperature taken twice a day
	Treatment	Propanolol prescribed on admission, given twice a day for at least 2 days	Iron and folic acid (or Inferon®) prescribed during stay	3 antibiotics prescribed concurrently during stay (Gentamycin, Metronidazole, and Ampicillin or Penicillin)
Management of critical event	Treatment/ critical event	$MgSO_4$ given in case of convulsion	Transfusion given (or prescribed) in case of Hb<5g/l or shock	Laparotomy performed in case of peritonitis or pelvic abscess

[6] Obviously, the management of a patient requires more than four important tasks, but for our purposes we restricted the number studied to four.

mance according to standards and on patient outcomes for all patients admitted with suspicion of each condition during a period before the CMM was introduced (called the "before" period) and again during a period after its introduction (called the "after" period).

The pre-eclampsia CMM was introduced in June 1999, so data on PIHD and PID patients were obtained for the 12-month period June 15, 1998, through June 14, 1999 (before), and the 12-month period September 15, 1999, through September 14, 2000 (after). A third round of data collection obtained follow-up data on PIHD performance to standards during the period September 2000 to January 2001. The PPH CMM was officially introduced in February 2000, approximately eight months after the introduction of the pre-eclampsia CMM, but was being used informally for a while before its official introduction. Before data on PPH were also collected during the same 12-month period as PIHD and PID (June 15, 1998, through June 14, 1999), but after data were obtained only for the 8.5-month period from January 1, 2000, through September 14, 2000, and compared to PID for the 12-month after period September 15, 1999, through September 14, 2000. The numbers of cases encountered in the retrospective record review in these periods were: PIHD (before = 36, after = 50, follow-up = 21), PPH (before = 20, after = 10), PID (before = 37, after = 29).

In addition to the record-abstracting tool, an event-tracking chart was used to document all changes in staffing, the facility, the blood bank, collaborating agencies, and access during 1999 and 2000. Dr. Abby Zziwwa, the medical anthropologist, developed a survey for providers to assess provider satisfaction with the CMM. The provider survey obtained opinions from 11 providers on the use of the CMMs.

E. Data Analysis

Data from the record abstraction were keyed into EPI Info from the record abstraction tools. Proportions and relative risk (RR) were calculated for the process and outcome indicators.

V. Results

A. Comparability of Study Groups

For each of the diagnoses, we compared the sample of women hospitalized before the CMM was introduced with the sample of women hospitalized afterward. For PIHD the before and after groups did not differ significantly on place of residence, mean age, referral source, parity, or diastolic blood pressure on admission (Table 5).

Table 5
Characteristics of Women with PIHD by Study Group

	Before CMM (N = 36)	After CMM (N = 50)	Test of Significance
Place of residence:*			
Jinja District:			
Metro Jinja	9 (25.7%)	16 (32.0)	Chi-sq = 3.10
Rural Jinja	13 (37.1%)	24 (48.0%)	p>0.2
Outside Jinja District:			
Mukono	10 (28.6%)	8 (16.0%)	
Others (Iganga, Kamuli)	3 (8.6%)	2 (4.0%)	
Age in years: Mean [SD]	24.1 [6.4]	24.2 [6.0]	T-test: t>0.2
Age categories:			
<18 years	5 (13.9%)	2 (4.0%)	p>0.2
18–34 years	30 (83.3%)	47 (94.0%)	
35+ years	1 (2.8%)	1 (2.0%)	
Referral source:			
Self	13 (36.1%)	23 (46.0%)	Chi-square = 0.84
Medical staff	23 (63.9%)	27 (54.0%)	p = 0.36
Jinja OPD as % of total	8 (22.0%)	15 (30.0%)	
Parity: Mean [SD]	3.2 [3.2]	3 [2.9]	T-test: t = 0.3 p>0.2
Gravida-para:			
Primi	19/36 (52.8%)	21/50 (42%)	p = 0.18
2–5	9/36 (25.0%)	22/50 (44%)	
Multi (>5)	8/36 (22.2%)	7/50 (14%)	
Diastolic BP on admission:			
Mean [SD]	102.5 [15.9]**	99.7 [13.3]***	p>0.2
Median	100	100	

* Comparison between two groups (Jinja District and outside: p = 0.07); ** Recorded for 32/36 patients = 89%; *** Recorded for 47/50 patients = 94%; "SD" means standard deviation; "OPD" means outpatient department.

However, the before group had more patients from outside Jinja District. Although this difference is not significant, there may have been a tendency to admit more patients from Jinja District itself.

The 20 patients in the PPH before group did not differ significantly from the 10 patients in the PPH after group with respect to place of residence, mean age, referral source, parity, or place of delivery (Table 6).

For PID (the control illness), the 37 patients in the before group did not differ significantly from the 29 in the after group with respect to place of residence, mean age, referral source, or parity (Table 7).

B. Use of CMM

Obstetric staff began using the CMM for pre-eclampsia after implementation on June 10, 1999. During the following three months (until September 14, 1999), 64 women were admitted with suspicion of PIHD. Of these, 63 (98.4%) had the new CMM used in the management of their cases. This indicates that the CMM was universally accepted and used for essentially all of the pre-eclampsia patients.

C. Performance According to Standards

Key tasks for normal management of each condition (see Table 4) were used as indicators to measure performance according to standards. It is likely that there was underreporting during the before period that was reduced in the after periods, which, if correct, would mean that the increases were less than reported here. The results of these measurements follow and are in Table 8.

Table 6
Characteristics of Women with PPH by Study Group

	Before CMM (N = 20)	After CMM (N = 10)	Test of Significance
Place of residence:*			
Jinja District:			
Metro Jinja	4 (20.0%)	1 (10.0%)	
Rural Jinja	110 (50.0%)	3 (30.0%))	
Outside Jinja District:			
Mukono	1 6 (30.0%)	2 (20.0%)	
Others (Iganga, Kamuli)	0 (0.0%)	4 (4.0%)	Fisher exact (regrouped) p = 0.12
Age in years: Mean [SD]	25.6 [6.2]	24.5 [6]	
Age categories:			
<18 years	1 (5.0%)	1 (10%)	
18–34 years	17 (85.0%)	9 (90%)	p>0.2
35+ years	2 (10.0%)	0	(regrouped))
Referral source:			
Self	12 (60.0%)	8 (80%)	
Trained medical staff	8 (40.0%)	2 (20%)	Fisher exact p = 0.25
Parity: Mean [SD]	4.2 [2.6]	4.0 [2.9]	
Parity:			
Primi	4 (20%)	2 (20%)	
2–5	9 (45%)	4 (40%)	p>0.2
>5	7 (35%)	4 (40%)	
Place of Delivery			
Home	2/19 (10.5%)	2 (20%)	Home vs. all others: p>0.2
Hospital unit/maternity	11/19 (58%)	2 (20%)	
Jinja Maternity	6/19 (31.5%)	6 (60%)	Jinja maternity vs. all others:Fisher exact (1-tailed) p = 0.14

Pregnancy-Induced Hypertensive Disorders

All indicators of provider performance for PIHD experienced large and highly significant improvements after the introduction of CMM (Table 8). The observed changes reflect a mix of actual increases in monitoring blood pressure and urine protein plus improvements in recording. When managed with the help of a CMM, patients were almost twice as likely to have a proteinuria test done on admission (RR = 1.95; [1.31–2.91]) and 25 times more likely to have their blood pressure taken three times a day (RR = 25.75 [3.71–178.35]). They were four times more likely to be prescribed propanolol on admission and for at least two days as the drug of first choice (RR = 4.25, [2.81–8.24]).

Postpartum Hemorrhage

For the management of postpartum hemorrhage, the difference in performance is not significant. This may be due to the small numbers involved: Only 10 patients presented after CMM implementation. However, the indicators for the investigation and monitoring of PPH both show an upward trend, with performance rising higher the longer the CMM was in effect. The trend is significant for hemoglobin tests performed on admission (RR: 1.52; [0.52–4.43], Fisher exact p>0.2 [1 tailed]), and for vaginal blood loss checked daily (RR = 3 [0.42<RR<17.16], X^2 Fisher exact: p = 0.15 [1 tailed]). However, no trend was observed for the treatment indicator (iron and folic acid, or Inferon®): (RR = 0.33 [0.05–2.41], X^2 Fisher exact: p = 0.23 [1 tailed]).

Table 7

Characteristics of Women with Acute PID by Study Group

	Before CMM (N = 37)	After CMM (N = 29)	Test of Significance
Place of residence:*			
Jinja District:			
Metro Jinja	6 (16.2%)	5 (17.2%)	Chi-sq = 0.71; df = 3; p>0.20
Rural Jinja	16 (43.2%)	10 (34.5%)	
Outside Jinja District:			
Mukono	7 (18.9%)	7 (24.1%)	
Elsewhere	8 (21.6%)	7 (24.1%)	
Age in years: Mean [SD]	31.4 [9.9]	30.1 [7.9]	t = 0.55; p>0.2
Age categories:			
<18 years	0/36 (0.0%)	1/28 (3.6%)	p = 014
18–34 years	22/36 (61.1%)	21/28 (75.0%)	
35+ years	14/36 (38.9%)	6/28 (21.4%	
Referral source:			
Self	30 (81.1%)	21 (72.4%)	Chi-sq = 0.70
Trained staff	7 (18.9%)	8 (27.6%)	p>0.2
Parity: Mean [SD]	33.4 [2.3]	3.3 [2.5]	T-test: t = 0.15 p>0.2

* Comparison between two groups (Jinja District and outside Jinja: p = 0.29).

Table 8

Percentage of Cases Performed According to Standards for Normal Management, Before and After Implementation

	BEFORE			AFTER				
Diagnosis/ Task	N	Number Correct	Percent Correct	N	Number Correct	Percent Correct	RR	Significance Level
PIHD (program)								
Urine test	27	13	48.1	50	47	94.0	1.95	P<0.001
BP thrice per day	33	1	3.0	50	39	78.0	25.75	P<0.001
Propanolol	33	7	21.2	50	45	90.0	4.25	P<.001
SUM/POOLED	93	21	22.6	150	131	87.3		
PPH (program)								
Hemoglobin test	19	5	26.3	10	4	40.0	1.52	p>0.2
Blood loss	4	1	25.0	8	6	75.0	3	p = 0.15
Iron & Folic acid	20	6	30.0	10	1	10.0	0.33	p = 0.23
SUM/POOLED	43	12	27.9	28	11	39.3		
PID (control)								
CBC	37	1	2.7	29	0	0	0	p>0.2
Temp twice per day	37	0	0	29	0	0	0	
3 antibiotics	37	16	43.2	29	18	62.1	1.44	p = 0.2
SUM/POOLED	111	17	15.3	87	18	20.7		

N is the sample size for the task (e.g., urine test once, BP three times) that should have been performed. “Temp” means “temperature taken.”

Acute Pelvic Inflammatory Disease

The management of patients in the control group did not differ significantly before and after (Table 8). The performance of a complete blood count on admission did not change significantly (X^2 p>0.2). Temperature was never taken twice a day in both groups. Ampicillin (or Penicillin), Gentamycin, and Metronidazole were more likely to be given jointly and parentally on admission after the communication of the treatment protocol (RR = 1.44 [0.9–2.29]), but not to a significant degree (X^2 p = 0.2).

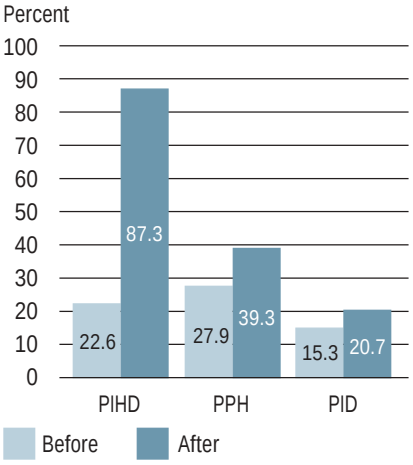
Number of Tasks Performed Correctly

Staff using the CMM to manage PIHD patients were 19 times more likely to perform all three key tasks than if no CMM was used (RR = 19.44 [2.77–136.56], X^2 p<0.001; see Table 8). For the PPH and PID groups, staff never performed all three key tasks, so no comparisons could be made. Staff were also more likely to perform at least one key task following the introduction of the CMM. For PIHD patients it was five times more likely after introduction of the CMM than before (X^2 p<0.001, RR = 4.94 [2.53–9.62]), and for PPH patients it was twice as likely with the CMM (X^2 Fisher exact: p= 0.01 [1-tailed], RR = 2.25 [1.27–4.00]). There was no significant difference in the correct performance of one or more key tasks for PID patients in the two time periods (X^2 p>0.2).

Figure 2 depicts the average number of tasks performed to standard for the three conditions before and after introduction of the maps. It shows that the increase in performance was largest for PIHD (from 22.6% to 87.3%), while for PPH performance increased but not significantly; and for PIH, the control condition, it increased only a small amount.

Figure 2

Increase in Percentage of the Three Normal Management Tasks Performed to Standard

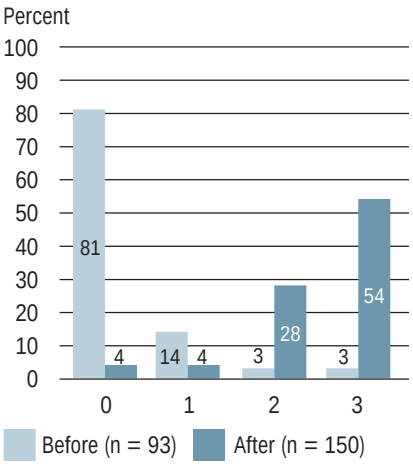


Pooled Key Tasks

We computed the number of tasks (out of three) performed to standard for each case. Figures 3, 4, and 5 show the distribution of the number of tasks performed correctly (0–3) before and after introduction. More tasks were performed to standard after introduction than before for all three conditions. For PIHD, no tasks were performed correctly for most cases (81%) before, whereas after introduction, most cases had two (28%) or three (54%) cases performed correctly (see Figure 3). For PPH, most cases had none or one task performed to standard before, compared to one or two tasks performed correctly after (see Figure 4). For PIH, all cases before and after had none or one case performed to standard, and never 2 or 3 (see Figure 5).

Figure 3

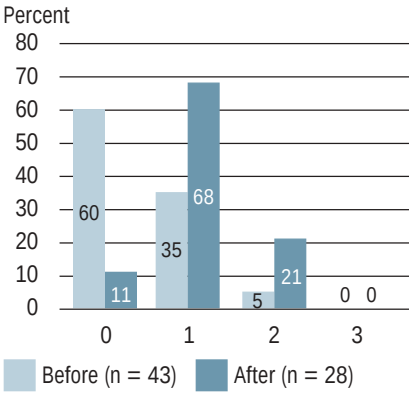
PIHD: Percentage of Pooled Key Tasks Completed Correctly for Normal Management Before and After Introduction of CMM



Tasks performed correctly: Protein urea test on admission, BP 3x/d, proponolol

Figure 4

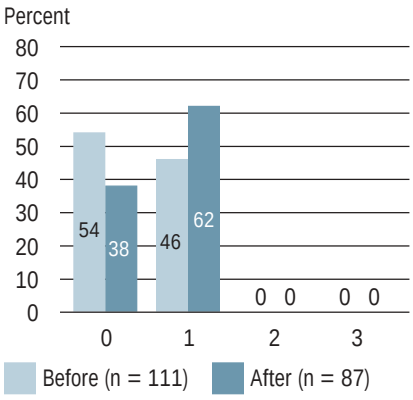
PPH: Percentage of Pooled Key Tasks Completed Correctly for Normal Management Before and After Introduction of CMM



Tasks performed correctly: Hb test on admission, blood loss checked daily, iron and folic acid

Figure 5

PID: Number of Pooled Key Tasks Completed Correctly for Normal Management Before and After Introduction of CMMs for Other Diagnoses



Tasks performed correctly: CBC on admission, temp 2x/d, 3 antibiotics parentally

D. Patient Outcomes

Pregnancy-Induced Hypertensive Disorders

Neonatal outcome (percentage of stillbirths), maternal outcome (percentage of women with pre-eclampsia proceeding to eclampsia), and case fatality rate were measured for each diagnosis. Patient outcome data were not collected for pre-eclampsia patients who were discharged before delivery or left the hospital against medical advice, so sample sizes for patient outcome indicators were reduced accordingly. For the women who stayed in the hospital, all three outcome rates improved after introduction of the CMM, but no improvement was statistically significant (Table 9).

Table 9

Patient Outcomes Resulting from the PIHD CMM

Indicator	Before (6/98–5/99)	After (9/99–8/00)	Relative Risk
Patient outcomes			
Cases that progressed to eclampsia*	11.1% (4/36)	8.0% (4/50)	0.72, p = 0.45
Stillbirths to women admitted for pre-eclampsia*	38.1% (8/21)	16.2% (6/37)	0.43, p = 0.06
Case fatality rate	5.9% (2/34)	4.1% (2/49)	0.69

* Some patients were discharged before delivery or left the hospital against medical advice, causing a reduction in sample size.

Postpartum Hemorrhage

During the study period, eight women with PPH died: one before the CMM protocol was designed or introduced, two after it was designed but before its introduction, and five after it was put in use. This abrupt increase in deaths from PPH just as the CMM was introduced is difficult to interpret. It is difficult to imagine how the use of a CMM might have contributed to those deaths. These five deaths occurred shortly after admission.

Retained placenta was the cause of five of the eight (63%) deaths from PPH. In these cases, the patients delivered at home and either arrived too late in the maternity ward to obtain a blood transfusion before dying (3/5) or else a blood transfusion could not be given for lack of blood (2/5). Of the five deaths that occurred during CMM use, two followed the pattern just described, one presented with coagulation disorders after an intrauterine fetal death, one died of cerebral malaria, and one suffered a cervical tear after the delivery of twins where blood transfusion was prescribed but none was available.

Acute Pelvic Inflammatory Disease

There was only one death in this group during the study period.

E. Resource Use

For patients with pre-eclampsia, the average length of stay increased with use of the CMM from 11.3 to 17.4 days. For PPH patients it decreased from 4.6 to 2.9 days (Table 10).

F. Providers' Attitudes and Perspectives

Eleven providers (two doctors, four senior nursing officers, and five midwives) were interviewed to elicit their perspectives on the introduction and use of the CMM for PIHD (Sebina-Zziwwa 2001).

All providers appreciated the management of PIHD through the use of a CMM. They found it easy to use and thought it contributed to better availability of medicines. In addition some said that it:

- Fostered self-confidence among providers (less consultation with higher-ranking staff);

Table 10
Length of Hospital Stay by Diagnosis, in Days

Diagnosis	Statistic	Before CMM	During CMM (Entire Stay)	During CMM (CMM Stay Only)[1]	Significance of Before-During (Entire Stay) Difference[2]
PIHD	N	29	50	50	
	Mean	11.3	17.4	8.1	p = 0.079
	SD	13.0	15.5	6.7	F = 3.15
	Median	8	12	NA	
PPH	N	17	10	10	
	Mean	4.6	2.9	1.4	p = 0.40
	SD	5.2	5.4	2.6	F = 0.65
	Median	3	0.5	NA	
PID (with outlier)[3]	37		NA	NA	
	Mean	8.2	NA	NA	p = 0.54
	SD	17.4	NA	NA	
	Median	5	NA	NA	
PID (without outlier)[3]	36		NA	NA	
	Mean	4.9	NA	NA	p = 0.30
	SD	2.4	NA	NA	
	Median	5	NA	NA	

[1] During the use of the CMM, we differentiated between the total length of stay in the hospital and that portion of the total stay during which a CMM was used to manage care. For example, after PIHD patients' blood pressure had normalized, they sometimes stayed in the ward because of another medical indication, or, if there were multiple pregnancies, PIHD developed while the patient was under observation on the ward. This column contains measurements only for the portion of the stay managed with a CMM.

[2] Significance applies to the difference between the "Before" CMM length of stay and the entire "During" CMM length of stay.

[3] One PID patient ("outlier") stayed in the hospital a long time.

"NA" means not applicable.

- Gave patients confidence in nurses, which improved communication;
- Revealed more than a written report would;
- Allowed easy planning of activities and interventions with patients;
- Energized the staff. Nurses, laboratory technicians, and pharmacists were all more careful, and the nursing staff can run the ward more smoothly and effectively;
- Made staff feel that maternal morbidity/mortality had decreased;
- Did not decrease workload on the ward because not all staff meet CMM requirements;
- Changed communication and attitude of staff when monitoring patients;
- Increased the number of PIHD patients, perhaps due to Jinja's enhanced reputation and/or patients' better understanding of pre-eclampsia.

Some informants' direct and personal excitement were echoed in terms of:

"It fosters closeness between patient and provider as patients inquire more about their condition; they even request that their blood pressure be taken."

"Care on our ward has improved so much that pre-eclamptic patients from the private wing move to our wing because of the proper management through the CMM."

"It has made the work easy; we can identify mothers who need monitoring and take appropriate steps."

"We now get fewer 'fitting' mothers."

"I can work independently even in an outreach center because I have learned the new variety of drugs to give; they were unknown to me before."

Through visual plotting, some mothers and their attendants were able to understand and appreciate hypertension in pregnancy as a dangerous sign (disease). They reported,

"Once the mothers note and observe others with charts, they are quick to accept their condition."

"Before, people thought that eclampsia was due to other things,[7] *but now they understand it better."*

Very few problems were mentioned. One related to increased workload for a few who found the blood pressure recording demanding. They could not avoid it as they had previously, when task performance did not have to be regularly documented. Another related to mothers not willing to stay in the hospital, which makes fully applying the CMM impossible. For PPH, there were also concerns relating to the difficulty in identifying abnormal bleeding. A typical response was: "With PPH, it is difficult because bleeding after birth is normal and it is not easy to tell heavy bleeding from normal."

We could interview only two patients whose care had been managed with a CMM. One had delivered, and the other was being treated for pre-eclampsia related to a multiple pregnancy. Both expressed their satisfaction and appreciated the regular attention from the staff.

VI. Discussion and Conclusions

We believe that the improvement in performance to standard in the PIHD group was due to the development and use of the CMM. We note that performance did not change significantly in the PPH or control group.

The observed improvements in PIHD performance are probably due to the process of developing the CMM and the new protocol as well as the map itself. The development process included many steps, several of which are likely reasons for the apparent success of the intervention. The steps most likely to have improved staff performance are reviewing and modifying case management standards; ensuring that adequate drugs and equipment (i.e., blood pressure cuffs) are available; and possibly most important, the involvement of key hospital staff members. The resulting team building and strong sense of ownership contributed to (1) the universal use of the CMM after it was introduced and (2) efforts to reduce medicine stockouts and find needed equipment and supplies. The success of the CMM in improving the quality of care is dependent on a continuous supply of medicines, availability of necessary monitoring equipment, and sufficient physicians to guarantee proper monitoring.

It is possible that the change in performance was not really a change of performance *per se*, but simply an improvement in documentation of performance. Better recording alone would be of some value, but there is good evidence that the performance itself did indeed improve. This is supported by several facts:

1. Recording of medications was always good at Jinja Hopspital. When the drug of choice for managing PIHD changed from alpha-methyl-dopa to propanolol, the frequency of notation did not change, but the prescription pattern did.
2. In the qualitative survey of the providers, one reported that the CMM "helps us to be more concerned and responsible because everyone has a role to play. We cannot be careless. Before, one could neglect to take the blood pressure; now you have to do it and sign that you did."
3. The four indicators for PIHD that improved are very specific to pre-eclampsia care. They are not general indicators that are likely to be influenced by other conditions.
4. The performance indicators, outcome indicators, and provider opinions all reinforce one another. Thus, the improvement in patient outcomes implies that the improvement in provider performance is substantially due to actual improvements in monitoring and not just to improvements in recording.

Patient management according to evidence-based clinical guidelines should lead to more favorable patient outcomes. In this study, we observed that with the CMM there was a significant increase in performance according to clinical standards as measured by the performance of key tasks for PIHD.

[7] This statement reflects a common local belief that pre-eclampsia and eclampsia are caused by adultery or witchcraft.

We therefore would expect a more favorable patient outcome for PIHD patients who are managed with a CMM. There was some evidence that managing PIHD patients with a CMM resulted in a more favorable patient outcome, as evidenced by the trend toward fewer stillbirths, fewer progressions to convulsions, and fewer deaths while in the hospital. However, none of these changes was statistically significant.

Improvements in the performance and outcome indicators for PPH were not as clear-cut. Several factors may explain this. (1) The sample of 10 was very small, making one wonder if the CMM was used for all PPH patients during the study period. (2) The increase in deaths from PPH that occurred at the time the CMM was introduced is perplexing. The analysis indicates that PPH due to a retained placenta was the most frequent reason for the hemorrhage. Further analysis revealed that the five patients who died with PPH were severely ill upon admission, and two had very difficult-to-manage and rare conditions—cerebral malaria and coagulation defects following an intrauterine fetal death. The CMM for PPH does not standardize for the management of the root cause of hemorrhage, but it encourages a more thorough assessment of the patient on admission and more adequate follow-up of the patient after the intervention on the root cause. (3) We explored the possibility of a change in referral patterns perhaps related either to intensified district health activities (which were indeed going on) or news of the improved care at Jinja Hospital, but found no clear evidence for such effects. (4) The PIHD CMM was introduced six months before the CMM for PPH, and therefore had more time to be effective. This suggests that the impact of CMM on compliance may increase with time. Patient outcomes increased significantly in PIHD with longer time use, but did not increase in PPH. (5) Finally, it may be that the CMM is better suited to PIHD, which responds well to case management, than to PPH, an emergency with multiple causes.

Limitations to this study include the small sample sizes, particularly in the PPH group. The total number of patients involved during the 18 months of observations was 86 for PIHD (36 before and 50 after) and 30 for PPH (20 before and 10 after). Factors other than the program, as yet unanalyzed, may have contributed to the observed improvements, especially activities occurring during the study period. Another concern is the effect of the patients who left the hospital before delivery and for which we have no outcome data. Follow-up with these patients would indicate whether their absence biased the results. Finally, it is important to remember that the intervention included both the CMMs and the development process. For instance, the local staff purchased supplies with their own funds to insure the standards implicit in the PIHD CMM could be met; without this part of the process, less improvement would likely have resulted.

VII. Recommendations

This study has shown that case management maps can be developed and used in a developing country setting. They were well received by the staff, who valued the CMMs both as a job aid and as a medical record.

The intervention improved compliance with clinical standards of care for PIHD and to a lesser extent for PPH. Even in the face of a major change in the treatment protocol for PIHD, in which alpha-methyl-dopa was replaced by propanolol, the new standards were fully followed. The study shows that CMMs, through the process of their development and subsequent use, can be useful tools for the communication, adaptation, and adherence to national clinical guidelines.

In the light of the achieved results, we recommend introducing the pre-eclampsia CMM in other settings, with one caveat. The substantial improvement in performance according to standard, along with the improved understanding and enthusiastic acceptance by hospital staff are a strong argument for widespread introduction of CMMs for PIHD care throughout Uganda and possibly in other countries. However, it is important to determine the relative contributions of the CMM itself and the development process before widespread application begins. We recommend its implementation and evaluation in a setting where a larger study sample and more reliable estimates are possible so that the relative contribution of the CMM and the development process can be ascertained.

CMMs for other conditions besides PIHD should be developed and, when successful, introduced widely. Further testing should be done with this CMM for PPH to answer the several questions raised about the study methodology and its efficacy. Lastly, CMMs for other types of care and settings should be developed and evaluated in light of what was learned in this study; they should be applied when proven successful.

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Appendix A: Case Management Map for Pre-Eclampsia

Case Management Map (CMM)

Pregnancy Induced Hypertensive Disorders

Name _____

Date of admission ____/____/____

Referred ❑ yes ❑ no

Identification number

Serial / IP number ____ / _____

Starting Page

Date ____/____/____ (D / E / N)

Check 3x/day

Blood Pressure (Systolic / Diastolic)

200 · 180 · 160 · 140 · 120 · 100 · 80 · 60

Fetal Heart Rate

170 · 160 · 150 · 140 · 130 · 120 · 110 · 100

Convulsions*

Initials ➢

Check 1x/day

Result | Initial | Result | Initial | Result | Initial

- Edema (Ed)
- Weight (Wght)
- Hyperreflexia (HypR)
- Proteinuria (Prot)

Give

Result | Initial | Result | Initial | Result | Initial

- Inderal 80 mg BD (Ind)
- Aldomet 250(-500 mg) tds (Ald)
- Diazepam 5 mg tds (Diaz)

Counsel

Result | Initial | Result | Initial | Result | Initial

- Restricted salt
- Bedrest left side
- Check Newborn Breastfed* (BrF*)

* *or* ▢ = *Possibility of critical event*

Jinja Hospital – Maternity – 1999

Problems in the Management of the Patient			
Date	Problem	Reason	Action

Critical Events	Standard Action			
1. Convulsion	Call Doctor – Put I.V. drip – Prepare MgSulfate **Magnesium Sulphate:** *Dosage:* 4 gr I.V. – slow 5 minutes 5 gm deep I.M. in each buttock *Side effects:* Hyporeflexia Use Ca gluconate *Contra-indication:* Hepatic impairment	Comments	Date	Time
2. Blood pressure not lowering after 2 days of correct treatment	Combine with second line anti-hypertensive tabs Aldomet 500 mg	Comments	Date	Time
3. Fetal heart rate >160 or <90/minute	Fetal distress – Call Doctor – Prepare for C-section	Comments	Date	Time
4. Newborn not breastfed	Examine child for hypothermia – Call Doctor	Comments	Date	Time

Patient Outcome at Discharge *(please circle correct statement)*				**Date of Discharge**
	Alive	Death	Absconded	
If woman alive:				
Blood pressure mother: /				/ /
Type of delivery:	Vaginal	C-section	Undelivered	
			Date of next appointment with medical officer or consultant:	
Status newborn:	Alive	Death		

Appendix B: Instructions for Case Management Map for Pre-eclampsia

Pre-eclampsia: any woman pregnant, in labor or having recently delivered, presenting with or developing a BP of 140/90 or more and/or edema, signs of proteinuria, headache, dizziness. It is a serious condition of pregnancy or delivery.

This Case Management Map (CMM) is designed to help you manage a patient with pre-eclampsia. To manage a patient well, we need to know several things, we need to monitor several things and we need to write this down so others can know what the patient's situation is, what has been done and can help us manage the patient.

Page 1

On admission of the patient we take the pink starting page

1. We want to know general information about the patient

- *Name* of patient
- Whether the patient is *referred* or not
- The *IP number*
- The *date*

Ask and fill in

2. Then we want to assess the patient

CHECK THREE TIMES A DAY

- Check *blood pressure* 3 times a day
- Check *fetal heart rate* 3 times a day (If the woman has already has delivered this does not need to be done of course)
- Check for *fits* (convulsions) 3 times a day

Initial for these three points when done

Write down: No fits (convulsions) note (-)
Fits (convulsions) note (+)

If she has fits, this is called a critical event. A critical event is those signs and symptoms occurring in a patient that entail changes of diagnose and/or therapy. We note it on the back of the page. Treatment has to be adapted.

CHECK ONCE A DAY

Weigh the patient every morning—write down weight

- Check on *edema*

Write down: No edema: (-)
Only ankle: (+)
Ankle & Tibia: (++)
Edema of the face: (+++)

Initial when done

- Do a *urine protein test* in the morning—write down result

Write down: From + to +++

Initial when done

- Check on *hyperreflexia*

Write down: No hyperreflexia (-)
Hyperreflexia (+)

Initial when done

3. The patient needs medication

- Give *medicine* as prescribed

Inderal ® *and Diazepam* will be given on admission

You will note that on the 3rd day after admission, the area of BP is shaded. This is to remind you that if after 2 days of correct treatment the BP has not come down, the treatment should be changed and *Aldomet* ® added. This is called a critical event. A critical event is those signs and symptoms occurring in a patient that entail changes of diagnose and/or therapy.

Some drugs may not be available. This means that there is a problem. We go to the back of the page and write down what the problem is, the date it has occurred and what we have done about it.

Initial when done

4. Now we have given her medication, it is important for her to understand what her condition is about.

Counsel the patient: *Diet* with restricted salt
Bed rest on left side

Initial when done

5. If woman has delivered, check the status of the newborn each morning.

Initial when done

We use the follow-up page (yellow) if the starting page is full. Do not forget to put the number on the follow-up page (some patients stay a long time and may need many follow-up sheets).

Page 2

This space allows us to describe problems that have occurred, critical events and if the patient is discharged have some information about her status.

1. Problems

If there is a *problem* that does not allow you to carry out the task—write down the date the problem occurs, what the problem is, and what has been done about it. Example: Diazepam may not be available or Aldomet®

2. Critical events

A *critical event* is those signs and symptoms occurring in a patient that entail changes of diagnose and/or therapy. In the case of pre-eclampsia, it may be that the BP is not lowering after 2 days of correct treatment, or that she starts fitting or that the fetal heart is either low or not heard. We note *what the critical event is, when it occurred, and what has been done.*

3. Patient outcome at discharge

- Write down if patient was alive, dead or has absconded
- If alive, write down her blood pressure on discharge
- Write down what type of delivery she has had
- If she delivered on the ward, write the status of the baby.

Appendix C: Case Management Map for Postpartum Hemorrhage

Case Management Map (CMM)

Post Partum Hemorrage

Name _____

Referred ❑ yes ❑ no

Identification number

Serial / IP number _____ / _____

Admission

Date ___/___/___

Time _____

Intervention on Root Cause

Date ___/___/___

Time _____

Post Intervention Follow-up

Starting Page

Date ___/___/___ (D E N) | Date ___/___/___ (D E N) | Date ___/___/___ (D E N)

Check Blood Pressure

Systolic: 140 / 120 / 100

Diastolic: 80 / 60 / 40

Check Temperature

40 / 39 / 38 / 37 / 36

Consciousness

Pulse

Initials ➢

Lab Test

	Result	Initial
HB		
Group-X Matching		

Determine Cause

check all that apply

- Retained Placenta ☐
- Laceration/Tear ☐
- Atonic Uterus ☐
- Coagulation Defects ☐

Initials ➢

Counsel

	Result	Initial
Condition		
Possibility Blood Transfusion, Surgery		

Check Newborn

- Breastfed
- Care of Cord

Please refer to appropriate Guidelines

- Retained Placenta ➢ Remove ☐
- Laceration/Tear ➢ Repair ☐
- Atonic Uterus ➢ Bi manual Comp +* ☐
- Coagulation Defects ➢ Fresh Blood* ☐

*see Guidelines

Check

- Lab: HB
- Check Vaginal Blood Loss

Give Medicine

X-Penicillin 2 M I.V. q.i.d. (1 2 3 4)

- Gentamycin 80 mg I.V. tds
- Amoxicilline 500 mg caps p.o. tds
- Metronidazole 400 mg caps p.o. tds
- Ferous Sulphate 200 mg tds
- Folic Acid 5 mg once a day

Blood Transfusion (please circle correct statement below)

Prescribed:	Yes	No	Not Applicable
If prescribed, given:	Yes	No	

Counsel

- Vaginal Hygiene
- Value of Antenatal Care and Family Planning

Check Newborn

- Breastfed
- Care of Cord

= *Possibility of critical event*

Jinja Hospital – Maternity – 2000

Problems in the Management of the Patient					
Date	Problem			Reason	ActionTaken
	Drug Shortage	No Blood Available	Other		

Critical Events	Standard Action			
1. Temperature elevated 24 hours after intervention on root cause	Do BS - MPS Look for features of puerperal sepsis Adapt treatment	Comments	Date	Time
2. Hemoglobin less than 5 mg%	Transfuse	Comments	Date	Time
3. Severe vaginal blood loss after intervention on root cause	Call Doctor - review causes	Comments	Date	Time

Patient Outcome at Discharge *(please circle correct statement)*				**Date of Discharge**
	Alive	Death	Absconded	/ /
If woman alive:				
HB at discharge:	/			
Status newborn:	Alive	Death		**Date of next appointment with medical officer or consultant:** / /

Case Management Map (CMM)

Post Partum Hemorrage

Name ________________________________

Referred ❑ yes ❑ no

Identification number
Serial / IP number ________ / ________________

Post Intervention Follow-up

Follow-up Page

		Date ___/___/___			Date ___/___/___			Date ___/___/___			Date ___/___/___			Date ___/___/___			
		D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	
Check Blood Pressure	Systolic **140**																**140**
	120																120
	100																**100**
	Diastolic 80																80
	60																60
	40																40
Temperature	40																40
	39																39
	38																38
	37																37
	36																36
Consciousness																	
Pulse																	
Initials ⋗																	
Check		Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	
Lab: HB																	
Check Vaginal Blood Loss																	
Give **Medicine**		Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	
Amoxicilline 500 mg caps p.o. tds																	
Metronidazole 400 mg caps p.o. tds																	
Ferous Sulphate 200 mg tds																	
Folic Acid 5 mg once a day																	
Blood Transfusion		*please circle correct statement below*			*please circle correct statement below*			*please circle correct statement below*			*please circle correct statement below*			*please circle correct statement below*			
Prescribed:		Yes No Not Applicable			Yes No Not Applicable			Yes No Not Applicable			Yes No Not Applicable			Yes No Not Applicable			
If prescribed, given:		Yes No			Yes No			Yes No			Yes No			Yes No			
Counsel		Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	Result / Initial	
Counsel at discharge on value of antenatal care and family planning																	
Check Newborn																	
Breastfed																	
Care of Cord																	

▢ = *Possibility of critical event*

Jinja Hospital – Maternity – 2000

Problems in the Management of the Patient					
Date	Problem			Reason	ActionTaken
	Drug Shortage	No Blood Available	Other		

Critical Events	Standard Action			
1. Temperature elevated 24 hours after intervention on root cause	Do BS - MPS Look for features of puerperal sepsis Adapt treatment	Comments	Date	Time
2. Hemoglobin less than 5 mg%	Transfuse	Comments	Date	Time
3. Severe vaginal blood loss after intervention on root cause	Call Doctor - review causes	Comments	Date	Time

Patient Outcome at Discharge *(please circle correct statement)*				**Date of Discharge**
	Alive	Death	Absconded	/ /
If woman alive:				
HB at discharge:	/			
Status newborn:	Alive	Death		**Date of next appointment with medical officer or consultant:** / /

Appendix D: Instructions for Case Management Map for Postpartum Hemorrhage

Postpartum Hemorrhage is the blood loss from the genital track after delivery of the baby that is perceived by the health worker to be excessive, dangerous and can endanger the life of the woman.

This Case Management Map (CMM) is designed to help you manage a patient with Postpartum Hemorrhage (PPH). To manage a patient well, we need to know several things, we need to monitor several things and we need to write this down so others can know what the patient's situation is, what has been done and can help us manage the patient.

Page 1

On **admission** of the patient, we take the green starting page

1. **We want to know general information about the patient**
   - *Name* of patient
   - Whether the patient is *referred* or not
   - The *IP number*
   - The *date*

   As hemorrhage can kill if not acted upon
   - write *time of admission*

   Ask and fill in

2. **Then we want to assess the patient and know what the cause of the bleeding is**
   - Check *blood pressure*
   - Check *consciousness*

     Write down: Conscious: (+)
     Unconscious: (-)
   - Check *pulse*

   Fill and Initial for these three points when done
   - Take blood for *HB test,* grouping and crossmatching
   - Determine why she is bleeding. Check all causes that apply

   Fill and Initial when done

3. **We want to explain to the mother and the family what her conditions is and what may need to be done to her**
   - Counsel on condition and possibility of blood transfusion and surgery

   Initial when done

4. **We need to check how the newborn is doing**
   - Check whether new-born is breastfed
   - Check how the cord has been cared for

   Initial when done

   Note: of course, if the baby has died during delivery this does not apply—simply cross out that section

As we now know the cause of bleeding, we are going to **Intervene on the root cause**

(Either the midwife or the doctor will do this—they will follow appropriate guidelines)

- Write *date and time* of the intervention
- Tick off the *type of the intervention* done on the patient

It is the person doing the intervention that writes it on the CMM

After the intervention we need to follow up on the patient as she is probably anemic, may have an infection or may continue with bleeding:

Post intervention follow-up

1. **We want to check *three times* a day on important symptoms**
   - Check *Blood Pressure*
   - Check *Temperature*
   - Check *Consciousness*

     Write down: Conscious: (+)
     Unconscious: (-)
   - Check *Pulse*

   Initial when done

2. We will chec*k once* a day

- Check Vaginal *blood loss* (is the woman still bleeding?)

  Write down if vaginal blood loss is

  Normal: (0)
  Moderate: (+)
  Severe: (++)

- For the *first day* after the intervention, *HB test* will be done.

Initial when done

(You will see that these areas are shaded light grey – this is to draw your attention to the fact that if the HB is low or the woman is bleeding this is a **"Critical event"** and action should be taken) A critical event is those signs and symptoms occurring in a patient that entail changes of diagnose and/or therapy.

5. The patient needs medication

- *X-pen, Gentamycine* will be given the first day to be replaced by *Amoxicilline and Metronidazole* the second.
- Routine wise *Iron and Folic acid* are prescribed

Initial each time the medicine is given

Depending on the situation of the mother, the Doctor may prescribe a blood transfusion.

- Each day is checked if there is a *blood transfusion prescribed*. If it is, you circle yes.
- As *blood* is sometimes not available, we now check if it has been *given*. If not, we circle no. This means that there is a problem. We go to the back of the page and write down what the problem is, the date it has occurred and what we have done about it.

6. Now we have intervened on her hemorrhage, it is important that the patient maintains correct vaginal hygiene. We also want to talk about the value of family planning so she can space her pregnancies and antenatal care if she is pregnant.

- Counsel on correct *vaginal hygiene*
- Counsel on value of *antenatal care and family planning*

7. We need to check how the newborn is doing

- Check whether new-born is *breastfed*
- Check how the *cord* has been cared for

Initial when done

Note: of course, as before, if the baby has died during delivery this does not apply—simply cross out that section.

We use the follow-up page (white) if the patient stays for more than 4 days.

We need to continue to follow-up on the patient as she is probably anemic, may have an infection or may continue with bleeding:

Post intervention follow-up

1. We want to check *three times* a day on important symptoms

- Check *Blood Pressure*
- Check *Temperature*
- Check *Consciousness*
- Check *Pulse*

Initial when done

2. We will chec*k once* a day

- Check Vaginal *blood loss* (is the woman still bleeding?)
- *HB test* will be done when requested by the doctor.

Initial when done

(You will see that these areas are shaded light grey—this is to draw your attention to the fact that if the HB is low or the woman is bleeding this is a **"Critical event"** and action should be taken). A critical event is those signs and symptoms occurring in a patient that entail changes of diagnose and/or therapy.

3. The patient needs medication

- *Amoxicilline and Metronidazole* are continued
- Routine wise *Iron and Folic acid* are prescribed
- Other drugs may be prescribed

Initial each time the medicine is given

Depending on the situation of the mother, the Doctor may prescribe a blood transfusion

- Each day is checked if there is a *blood transfusion* is *prescribed;* if it is you circle yes.
- As *blood* is sometimes not available, we now check if it has been *given*. If not, we circle no. This means that there is a problem. We go to the back of the page and write down what the problem is, the date it has occurred and what we have done about it.

4. On the day the woman will be discharged we will to remind her about the value of family planning so she can space her pregnancies and antenatal care if she is pregnant.

- On discharge, counsel on value of *antenatal care and family planning*

5. We need to check how the newborn is doing

- Check whether new-born is *breastfed*
- Check how the *cord* has been cared for

Initial when done

Note: of course, as before, if the baby has died during delivery this does not apply—simply cross out that section

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This space allows us to describe problems that have occurred, critical events and, if the patient is discharged, have some information about her status.

1. Problems

If there is a *problem* that does not allow you to carry out the task - write down the date the problem occurs, what the problem is and what has been done about it.

Ex. Blood may not be available or gentamycine may not.

2. Critical events

A *critical event* is those signs and symptoms occurring in a patient that entail changes of diagnose and/or therapy. In the case of post partum hemorrhage it may be that the woman develops fever, has a very low HB or severe vaginal blood loss or. We note *what the critical event is, when it occurred and what has been done.*

3. Patient outcome at discharge

- Write down if patient was alive, death or has absconded
- If alive, write down her hemoglobin
- Annotate the status of the baby.

Abstract *Continued*

the control condition in part because it was treated in the gynecological ward, physically separate from the maternity ward where PIHD and PPH were treated. Different staff treated the intervention conditions and the control condition. The PID sample sizes were 37 cases before and 29 after.

The results with PIHD were clear. Pooled adherence for all three normal management indicators increased from 22.6% to 87.3% for PIHD; the difference was highly significant. In contrast, pooled adherence for the PID comparison group rose only slightly from 15.3% to 20.7%. Patient outcomes also improved for PIHD patients after the CMMs were implemented, but not so dramatically, nor were they statistically significant. In the study sample, fewer cases of pre-eclampsia progressed to eclampsia (11% before, 8% after), a highly desirable outcome. In addition, fewer stillbirths (38% before, 16% after) and fewer maternal deaths occurred (5.9% before, 4.0% after, and 0.7% at follow-up a year later). These results are probably due to the new protocol for managing PIHD (including new medications and the CMM) and the process of developing and implementing the protocol and the CMM. Until the relative contribution of the CMM itself and its development process can be assessed, care should be taken in attempting to generalize the result to other settings.

The results of the CMM for PPH were not so clear. Average adherence to the three care standards for PPH increased from 27.9% to 39.3% following the introduction of this CMM; this increase was comparable in magnitude to the increase observed for PID, the control condition. The number of maternal deaths from PPH actually increased, from only one death in the before period to five after. A careful analysis of these deaths did not explain the increase, but it may have been due in part to this CMM's small sample size and in part that staff may have needed more time to gain proficiency in the use of the PPH CMM.

We conclude that for PIHD, the development and use of CMMs clearly improved the process of care and perhaps patient outcomes. However, the impact of the PPH CMM on care and outcomes was small at best. Before going to scale, information is needed about which conditions benefit from CMMs and which do not, and about the relative contribution of CMMs separate from the process of developing them.