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Health information system strengthening during antenatal care in Haiti: Continuous quality improvement

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Table of Contents

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Abstract

Background: Journey to 9 Plus (J9) is an integrated Reproductive, Maternal, Neonatal, Child Health (RMNCH) approach to care in rural Haiti. To show the impact of this program it is necessary that data collection be of the highest quality. In the J9 program monthly reports, it was found that chart loss was contributing to incomplete and inconsistent reports. Initial evaluation of the quality of EMR data entry showed only 15% of J9 prenatal visits were being documented electronically at the start of this quality improvement project.

Objective: This study aimed to improve the electronic documentation of outpatient prenatal care provided from 18% to 85% into the UHM EMR by J9 staff, from January to September of 2021.

Methods: A continuous quality improvement (CQI) strategy was undertaken as the best approach to improve the EMR data collection at University Hospital Mirebalais (UHM). The team used several QI tools to conduct this project including: (1) a root cause analysis using Ishikawa and Pareto diagrams; (2) baseline evaluation measurements; and (3) Plan-Do-Study-Act (PDSA) improvement cycles to document incremental changes and the results of each change.

Results: Documentation of prenatal point of care visits in the EMR was complete for 15% of patient contacts at the start of this QI project, in November 2020. This increased to an average of 89% of J9 prenatal visits entered every month by the conclusion of the project in September 2021.

Conclusions: The experiences that this quality improvement project team encountered can contribute to the transition from paper to electronic documentation within burgeoning health care systems. Essential to success was having strong and dedicated nursing leadership to transition from paper to electronic data and motivated nursing staff to carry out data collection to improve the quality of data and thus the reports on patient outcomes. Engaging the nursing team closely in the design and implementation of the EMR and quality improvement processes ensures long-term success while centering nurses as key change agents in patient care systems.

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ABSTRACT

Background

Journey to 9 Plus (J9) is an integrated Reproductive, Maternal, Neonatal, Child Health approach to care that has at its core, the goal of decreasing the rate of maternal and neonatal morbidity and mortality in rural Haiti. To show the impact of this program, it is necessary that the data system be of the highest quality. OpenMRS, an Electronic Medical Records system (EMR) was already in place throughout the tertiary referral University Hospital Mirebalais in Haiti and expanded for J9 data collection and reporting. In the J9 program monthly reports, it was found that staff had limited time and capacity to carry out double charting which contributed to incomplete and inconsistent reports. Initial evaluation of the quality of EMR data entry showed only 18% of J9 antenatal visits were being documented electronically at the start of this quality improvement project.

Objective

This study aimed to improve the electronic documentation of outpatient antenatal care from 18% to 85% into the EMR by J9 staff, from November 2020 to September 2021. The experiences that this quality improvement project team encountered could help others improve electronic data collection as well as the transition from paper to electronic documentation within a burgeoning health care system.

Methods

A continuous quality improvement (CQI) strategy was undertaken as the best approach to improve

the EMR data collection at University Hospital Mirebalais. The team used several CQI tools to conduct this project including: (1) a root cause analysis using Ishikawa and Pareto diagrams; (2) baseline evaluation measurements; and (3) Plan-Do-Study-Act improvement cycles to document incremental changes and the results of each change.

Results

At the beginning of the quality improvement project in November 2020, the baseline data entry for antenatal visits was 18%. Ten months of improvement strategies resulted in an average of 89% of antenatal visits documented in the EMR at point-of-care every month.

Conclusions

The experiences that this quality improvement project team encountered can contribute to the transition from paper to electronic documentation within burgeoning health care systems. Essential to success was having strong and dedicated nursing leadership to transition from paper to electronic data and motivated nursing staff to carry out data collection to improve the quality of data and thus the reports on patient outcomes. Engaging the nursing team closely in the design and implementation of the EMR and quality improvement processes ensures long-term success while centering nurses as key change agents in patient care systems.

INTRODUCTION

“Journey to 9 Plus” (J9) is a comprehensive Reproductive, Maternal, Neonatal, Child Health (RMNCH) approach to care that has at its core, the goal of decreasing the rate of maternal and neonatal morbidity and mortality in Haiti. According to the World Bank, Maternal Mortality in Haiti is 350 per 100 000 live births(1) and Neonatal Mortality is 24 per 1000 live births(2). To show this program's impact, data collection must be of the highest quality to be of value. The J9 program was initiated in July 2018 at University Hospital of Mirebalais (UHM), a Zanmi Lasante (ZL) and Partners In Health (PIH)-supported tertiary referral hospital located in the Central Plateau of Haiti. The four pillars of this RMNCH approach encompass: group antenatal care, group pediatric appointments, home visits and psychosocial screening, counseling and support. The program serves women and their families in the Mirebalais catchment area that has a population of 97,755(3). The team initiating J9 at UHM, primarily staffed and run by nurses, helped to improve and expand the data capture within the existing Electronic Medical Records (EMR), an OpenMRS system(4) data collection platform. This Continuous Quality Improvement (CQI) project was conducted with the PIH Health Information Systems (HIS) team located in Boston, MA.

Problem Description

Working in rural Haiti where there is limited access to Electronic Medical Records (EMR), means monthly reports depend upon paper-based patient charts and registers transferred into electronic form. Depending on the quality of the transfer of this data, values are sometimes not transcribed correctly from the paper register format. Other times, physical charts go missing along with entire patient histories – including years of lab results, prescription history, documentation of illnesses, hospitalizations, surgical interventions, outpatient follow-up visits, etc., leaving providers with only the subjective history of the patient to rely on for continued care. This is not only frustrating for patients and providers but can impact wait times, contribute to medication errors, does little in terms of assuring quality of care, and can compromise patient health and safety(5,6).

The loss of prenatal, post-partum and/ or pediatric patient charts in addition to the use of paper registers had been contributing to incomplete and inconsistent reports. The provider must start a new empty paper chart each time a patient’s paper chart is lost or not located at the time of the visit. The ideal solution would be to enter all outpatient prenatal visit data into an EMR. At UHM, the OpenMRS EMR system was not consistently being used by medical providers including the J9 staff. A quality improvement project was initiated to address the gaps in the system and to ensure consistently more complete and high-quality reports.

Available Knowledge

A review of the literature on the role and impact of EMR in data collection in Low and Middle-Income Countries (LMIC) found that a robust EMR system is critical in RMNCH services to ensure quality of data collected thereby enhancing the quality of care provided to this vulnerable group(7). Additionally, social needs can be assessed and managed, particularly for vulnerable populations using EMRs in clinical settings(8). Health Information Systems (HIS) have been shown to have the potential to improve the quality of care provided to patients by increasing adherence to guidelines, enhancing disease surveillance, and decreasing medication errors(8–11).

An EMR system provides important health and safety benefits(9) In LMIC settings, it has been shown to reduce wait times and medication order errors(12). However, experience from global health informatics projects shows the need for a thorough understanding of the local environment and population in low-resource settings such as those in LMIC's(11,13). Despite challenges facing LMIC, studies have shown how EMRs can succeed with support if an EMR is designed and implemented to fit into local environments(6). Additionally, routine data quality assessments of EMR's have been associated with improvements in data quality in LMIC(14), with timeliness, availability of data for health reports and with staff satisfaction with an electronic system, compared to paper-based(15). Using health management information system (HMIS) data is an important part of the CQI process and leads to improving data quality(16).

Rationale

To our knowledge, this is the first study to describe the use of CQI methodology to enhance EMR data quality/use and improve the quality of care in maternal and newborn services in a comprehensive maternal and newborn care program in rural Haiti.

Data collected through an EMR is more accessible and reliably stored. A closer examination of the J9 program exposes how point of care data entry into an EMR-based system can be advantageous for numerous reasons in the context of rural Haiti. For example, critical patient data such as prenatal risk factors, history, blood pressure and other vital signs, lab results and Syphilis/HIV status are all essential in the provision of continuity of care. Prenatal care optimizes both the outcomes and experiences of maternal health care for pregnant women along with outcomes for newborns(17).

Access to paper patient charts at each prenatal visit for documentation, as well as during any hospitalizations or at the time of delivery and post-partum is essential for point-of-care decision-making in cases of prevention of vertical disease transmission, pre-eclampsia diagnosis, treatment of infections, etc, which therefore ensures compliance with updated recommendations to ensure high quality of care. The loss of data through a paper-based system when charts are missing or lost during visits or at the time of delivery highlights the gaps in the continuity of care and therefore can increase risk of lack of treatment or follow up on previously detected illnesses.

Preparation of monthly reports from paper charts and registers transcribed into an electronic format to track key indicators exposes the difficulties faced and potential data loss in showing the impact of J9 on maternal and newborn health. Improved electronic data collection at point of care including lab results, translates to easier storage for analysis, reporting and follow up care; therefore impacting quality of care. This translates to reports that can illustrate the effects of an accompaniment model and its impact on maternal and neonatal morbidity and mortality. An EMR system can contribute to the improvement of data quality, however, reliable internet access, motivated staff willing to enter the data in the EMR system, hardware and appropriate software available as well as updates to the system to adapt to the needs of the local team are all essential to an operational system(11,13,15).

At the start of the improvement project at UHM, a major challenge was that the EMR had the capacity to collect only half of the essential prenatal data during a point-of-care visit; compared to the data collected on paper charts. This was due to the launch of an EMR before it met all the needs of the team on the ground, resulting in the staff having to double chart (both on paper and electronically). Double charting is time consuming, can contribute to inconsistencies(15), and can

create staff and patient frustrations as the workflow is significantly impacted. However, this is reflective of the journey from paper to electronic systems in many under-resourced settings where paper-based patient charts are the norm but monthly reports are compiled in electronic format causing a duplication and overlap of data reporting(12,15,18).

Specific Aims

This study aimed to improve the electronic documentation of outpatient prenatal care provided from 18% to 85% into the UHM EMR by J9 staff, from January to September of 2021. The team fixed 85% as the target for the objective of this CQI project for two reasons. First, we wanted an attainable goal that, upon success, would motivate the team to continue to improve thus creating a sustainable result. Second, the EMR system is down on occasion that would prevent a goal of 100%. The data from the backup system of paper charts in these cases, is not always retrospectively entered into the EMR following visits. The experiences that this quality improvement project team encountered could contribute to the literature in terms of ways to improve electronic data collection as well as the transition from paper to electronic documentation within a burgeoning health care system.

METHODS

Continuous Quality Improvement (CQI) is described as a systematic and structured approach to improving an identified process or service, consisting of continuous feedback loops with outcomes measured and evaluated throughout the process (19). CQI is both a culture and a methodology that improves work processes, ensuring better outcomes. It is a philosophy that encourages all project team members to continuously ask how they can improve their work systems and is often associated with methodologies like Plan-Do-Study-Act (PDSA) cycles (20). Compared to research, CQI does not aim to create new generalizable knowledge, however, both QI and research require a consistent methodology. CQI intersects with research in the process to iteratively test conditions required to adapt published research findings to local context (21).

Context

A continuous quality improvement (CQI) strategy was undertaken to improve the collection of electronic data being entered into the EMR system at UHM. The team used several CQI tools to conduct this project including: baseline data collection; a root cause analysis using the Ishikawa diagram; the Pareto diagrams; Plan-Do-Study-Act (PDSA) improvement cycles to document incremental changes and analysis of the results of each change.

This quality improvement project team was led by TMJ, a Nurse leader at UHM and J9 program coordinator, other team members included a midwife (MCJB), nurse (JA), HIS team members in both Boston (EB) and Haiti (JJB), as well as a Pediatrician (MH). All CQI project team members are also involved in J9 activities and are invested in the success and sustainability of the program.

Ethics Approval and Consent to Participate

All methods of quality improvement were carried out in accordance with the regulations for human subjects research protections according to HHS (45 CFR part 46). As this was a quality improvement project, it did not involve any direct patient contact and all patient information in the datasets generated for the analysis was retrospective, de-identified and anonymous prior to analysis. For these reasons informed consent was waived for the purposes of this study. The original informed consent allows the secondary analysis without additional consent. The ethics committee that reviewed and approved the study protocol and waived the need for informed consent is: *Zanmi Lasante Institutional Review Board (ZL IRB)* in Haiti. In addition, approval for this CQI project was obtained by the '*Quality Improvement Committee of the University Hospital Mirebalais'* in Haiti. As the data analyzed was retrospective, no compensation was offered or received in this study.

Intervention

The quality improvement team used the standard quality improvement tools as outlined by Institute for Healthcare Improvement (IHI)(22) to improve the data entry into the EMR. The challenges faced in J9 were identified when a “root cause analysis” was performed at the start of this continuous quality improvement project. These key causes contributed to the baseline evaluation; only 18% of prenatal documentation of patient visits were being entered into the EMR(23). The Ishikawa or “fishbone” diagram (Figure 1) visibly displays and helps teams understand the multiple root causes that contribute to an effect and highlights areas for improvement(22). The team members identified and classified the causes under 4 categories: People/ Environment/ Equipment/ Procedures.

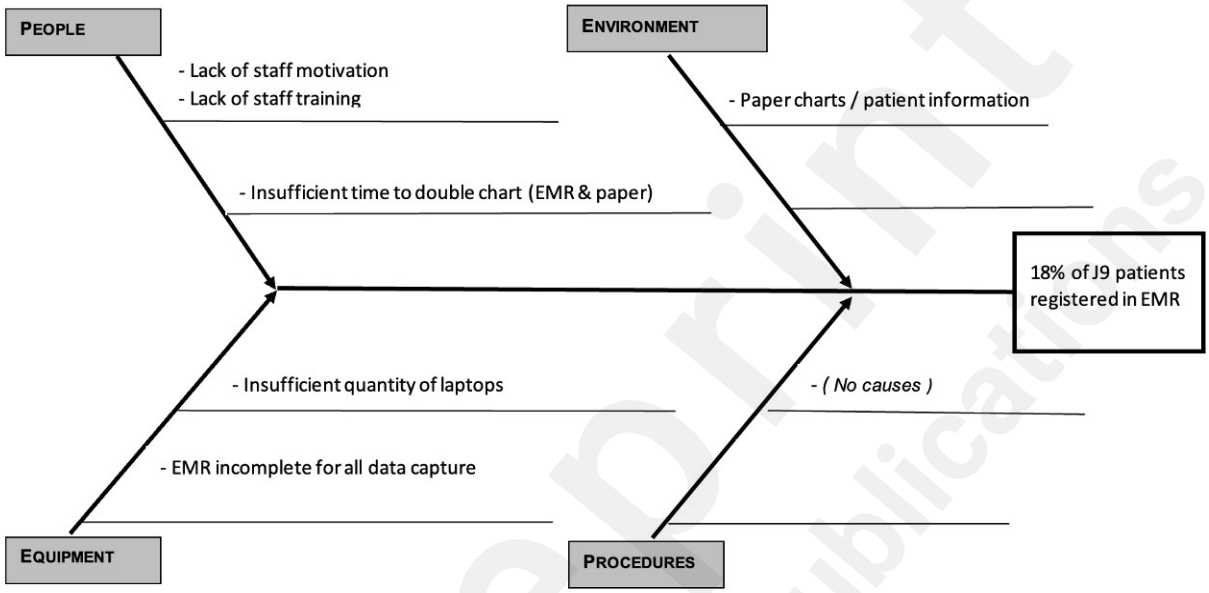

Figure 1: Ishikawa Diagram of Cause and Effect of maternal health antenatal EMR data entry quality improvement project at University Hospital Mirebalais (Haiti) (2020-2022)

The Pareto diagram (Figure 2) was created using the causes identified in the Ishikawa diagram. According to IHI, a Pareto diagram is a chart in which the various factors that contribute to an overall effect are arranged in descending order of importance according to the magnitude of their effect. This ordering helps a CQI team identify the "vital few" factors and helps a team concentrate its efforts on the factors that have the greatest impact. It also helps a team communicate the rationale for focusing on certain areas(22). For the purposes of this CQI project, the team calculated the mean percentage each “cause” or factor contributed to the low amount of prenatal data being entered into the EMR. The score was based on interviews with each member of the J9 team who were asked to rank the contributing factors that prevented them from entering the point of care data into the EMR on a scale of 1-10 with 10 being the factor that most contributed to the lack of data entry. “Insufficient time to double chart” was an average of 9/10, “Lack of staff motivation”, “Paper chart/ info loss”, “EMR platform incomplete”, “Lack of training” were all ranked at 7/10 and “Insufficient laptops” was ranked at 6/10.

According to the 80/20 rule whereby resolving 20% of the root causes will resolve 80% of the effects(22), the team was able to then focus on the “vital few” factors that made up 20% of the causes. In this case, the team addressed the root cause “Insufficient time to double chart” first. It is worth noting that the Pareto Diagram does not account for hidden factors such as: power outages, wireless/ internal EMR access issues, deficiencies in the user interface, user familiarity over time with electronic data entry, stress of sociopolitical unrest on staff, or exceptionally busy days that throw off normal patterns, etc.

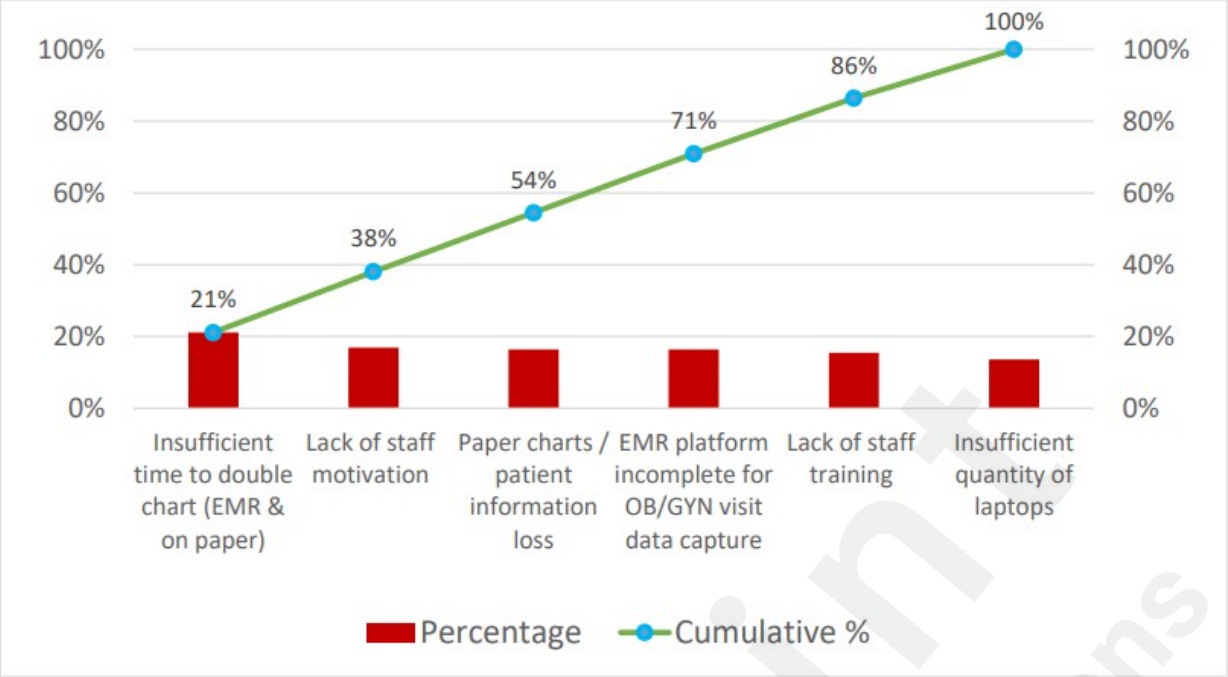

Figure 2 : Pareto Diagram of maternal health antenatal EMR data entry quality improvement project at University Hospital Mirebalais (Haiti) (2020-2022)

Measures

The indicator identified for this quality improvement project was the percentage of pregnant women enrolled in the J9 program, whose data was completely entered in the EMR system from November 2020 through September 2021. The numerator was the total number of pregnant women enrolled in J9 whose prenatal visit data was completely entered in the EMR; and the denominator was the total number of unique pregnant women enrolled in J9 who checked-in for their visit, captured through the EMR. Results were tracked for sustainability through April 2022. The team fixed 85% as the objective for this project.

The team reviewed the following elements which were analyzed for improvement: 1. Vital Signs (VS) 2. Gravity/ Parity/ Abortions/ Living (GPAL) 3. Last Menstrual Period (LMP) 4. Fetal Heart Tones (FHT) and 5. Fundal Height (FH). If entered, these indicate that the prenatal record was considered complete.

This data was captured monthly for the project's duration with the help of the Monitoring and Evaluation (M&E) team at UHM. The data indicator of LMP was chosen to indicate completeness because only the J9 staff would have entered this information in the EMR and at that time, LMP did not carry over to the next prenatal visit. The J9 staff interventions (completeness of prenatal data entry) would be affected by the interventions taken to improve this indicator and thereby directly impact the success of this CQI project.

RESULTS

Baseline Evaluation

The initial evaluation found 18% pregnant women enrolled in J9 whose GPAL and LMP was entered at their prenatal visit, in the EMR in November 2020(23). At this point in time, the EMR could not capture FHT or FH therefore these data points could not be considered in the "completeness" of the data entry. Other data entry points at the start of the project were as follows: VS: 99%, FHT: 0% and FH: 0% at the start of the project. (See Baseline Evaluation - November 2020 - in Figure 3).

	PLAN	DO	STUDY	ACT
December	Addressed the	Encouraged the J9 providers : 4	This cycle resulted	The team

2020: 1st PDSA	problem of "Lack of staff motivation" to enter data into the EMR	Nurses and 1 Nurse Midwife to enter the patient prenatal information at point-of-care, directly into the EMR system instead of onto the paper forms. Inaccessibility of the EMR system due to connectivity issues was a primary concern expressed; decision to use paper forms only when the system was down resolved this issue.	in an increase from 18% LMP to 20% data entry in February 2021 (see results in Figure 3).	decided to adapt the strategy and continue with a second cycle
May 2021: 2nd PDSA	Addressed the "Lack of staff training" on the EMR usage, training held on EMR data entry for the staff	ZL based HIS team conducted an EMR specific training on May 20 – 21, 2021, for the J9 staff.	This resulted in an increase from 13% of prenatal visits in had the LMP entered May 2021, to 52% of Prenatal J9 electronic data entered in June 2021	The team decided to adapt the strategy and continue with a third cycle
April-June 2021: 3rd PDSA	Addressed the root causes "Insufficient time to Double Chart" and "Incomplete EMR platform": A team of ZL medical leadership, J9 staff, M&E and HIS staff in both Haiti and Boston worked together to address EMR issues.	Addressed the needs of outpatient women's health staff at UHM, the hospital reporting indicators and the Open MRS system across the ZL network of hospitals and clinics in Haiti who will be using the platform for data collection and interpretation. Weekly team meetings to satisfy the needs of the stakeholders and to ensure quality data collection.	The results of this cycle showed an average of 89% of J9 prenatal patient data entered completely in the EMR.	The changes were adopted. The results have been sustained and the team continues to work without paper charts, unless the electronic system is inaccessible and back-up paper forms are necessary. The results of this third PDSA cycle and the sustained success can be seen in Figure 3.

Table 1: PDSA Cycles of improvement of maternal health antenatal EMR data entry quality improvement project at University Hospital Mirebalais (Haiti) (2020-2022)

When vital signs were analyzed, they were consistently entered for 95% of all J9 prenatal patient contacts throughout the entire project. On the other hand, GPAL and LMP, if entered, were consistently together. Other variables such as high-risk pregnancy diagnosis, medication prescription, pregnancy history and family history were entered as needed.

Analysis of Improvement

A total of 17,404 outpatient women's health visit records were extracted from the EMR from November 2020 through April 2022. Of these, 10,524 were prenatal patient visit records. Roughly half of the prenatal visits, or 5,561 point-of-care contacts were with patients enrolled in J9, and were included in the analysis. The 4,963 patient contacts with patients not enrolled in J9 were excluded from the analysis. An average of 309 (214-422) J9 prenatal check-ins were recorded each month in the EMR for the project duration(23).

The baseline evaluation showed that 18% of LMP and GPAL electronic data was captured during prenatal visits at the start of the CQI project. The EMR did not collect FHT's nor FH data at the beginning of this project.

To ensure sustainability of the changes, the team continued to measure the data being entered at point-of-care delivery and found the following:

1. Vital signs data continued to be entered 95% of the time.
2. FHT and FH data improved from 0% (November 2020 through May 2021) to 92% and 83% of FHT and FH respectively, being entered at prenatal visits starting in mid-June 2021.

In February 2022, the EMR was upgraded for user experience. The improvement included LMP and GPAL data to be entered only at the first antenatal visit and not at follow-up visits as these data points would not change throughout pregnancy. The runchart diagram (see Figure 3) shows an improvement in LMP and GPAL from 18% to 90% of prenatal contacts, dropping off drastically to 24-25% of prenatal visits starting after the EMR system upgrade. This is a positive reflection of data for LMP and GPAL no longer required for follow-up antenatal visits.

The team achieved their initial goal of 85% of J9 prenatal visits encounters having electronic data entry into the EMR of because of the interventions described in the PDSA cycles, which depended upon strong collaborative teamwork. The amount of data lost when using paper charts can be significant. The results from the first and second PDSA cycles show minimal change from baseline. However, the third PDSA cycle addressed the completeness of the MCH EMR and therefore the concerns of double-charting that were expressed by the staff from the beginning (see Table 1). The use of both paper and electronic charts was necessary when the EMR was incomplete. With the HIS system upgrade to include all of the data points prioritized by the UHM providers on the ground as feedback during the inter-professional Friday meetings; the Boston and Haiti HIS/ M&E teams were able to augment the OpenMRS EMR system to suit the needs of the providers on the ground. This project also took into consideration the required reporting indicators that are compiled each month when assembling the monthly report.

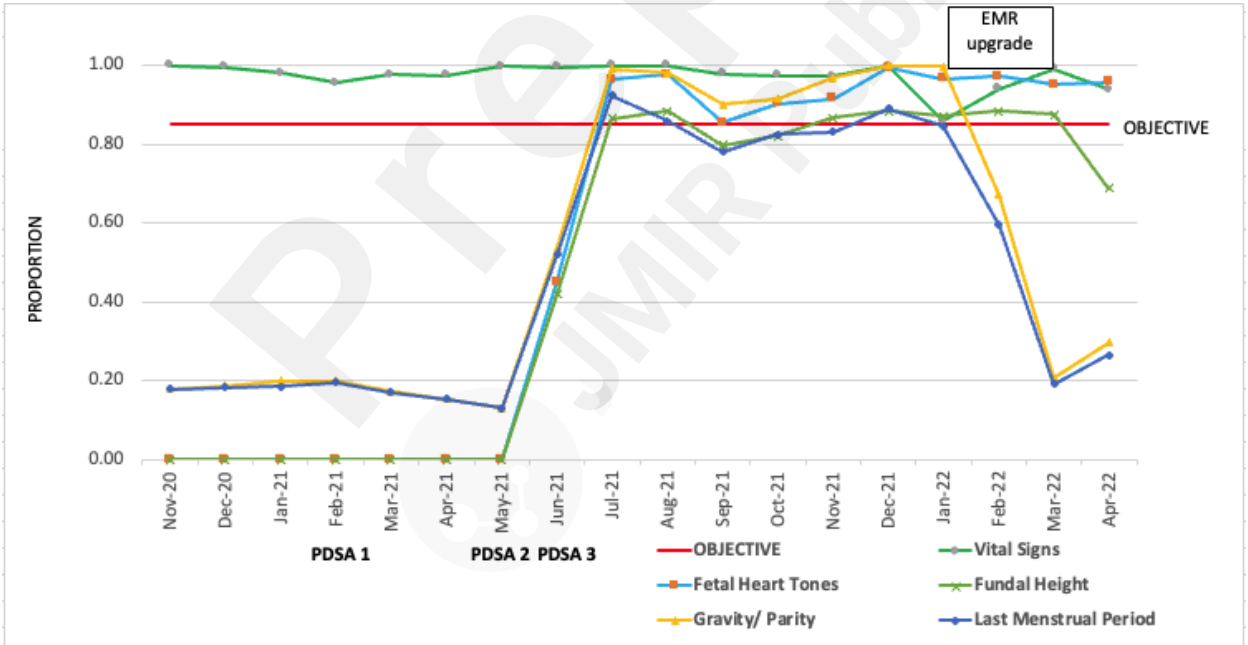

Figure 3: Runchart diagram showing all J9 maternal health antenatal visit results 2020-2022: University Hospital Mirebalais (Haiti), EMR quality improvement project. In February 2022, EMR system upgrade included Last Menstrual Period and Gravity/ Parity data to be only entered on the initial antenatal intake; this data was maintained throughout the current pregnancy.

DISCUSSION

Principal Results

An EMR system can contribute to the reduction in maternal and neonatal deaths through the

collection of high-quality data that can facilitate follow-up and recommendations and adherence to guidelines(7–10). According to the J9 approach of maternal, neonatal and pediatric group care whose objective is to reduce the rate of maternal and neonatal deaths, an EMR system is essential.

Point-of-care data entry of prenatal medical information directly into the EMR system was carried out by existing staff consisting of four (4) Nurses and one (1) Nurse-Midwife. No additional staff were hired to assist with the EMR data entry. When the EMR system was down, the staff used paper charts as back-up and later entered the information into the system. This data entry following the appointment, is time consuming and not always completed, explaining why the team did not reach 100% electronic data entry. The team hopes that the use of the EMR and the capability to sustain complete, high-quality data will therefore reduce the staff time compared to recording, reporting and searching through paper charts for specific patient information or care received. Transitioning from retrospective to point-of-care data entry has been a significant hump to get over.

The biggest improvements were based on enhanced clinical staff interface for data collection (PDSA 3), because it reduced the amount of time spent on data entry and allowed for one system for data collection. Importantly, the staff were willing to transition from double entry to prioritizing the EMR data collection. This highlights that nurses value a stable, point-of-care system with high quality data capture that has ultimately driven our transition. The expectation now is to continue providing significant benefits for J9 patients, staff and the organization to help sustain these improvements.

An effective EMR implementation could confer cost savings(10), even in a low-resource setting if it supports good documentation and access to key clinical data(24). These savings could improve health care efficiency and safety and that HIS-enabled prevention and management of chronic disease could eventually double those savings while increasing health and other social benefits(10). Cost savings can also be considered through reduction of medication errors and adverse drug events in ambulatory settings and reduction in repeat lab tests(24)and duplicate consultations. Studies showed improved patient safety from EMR use in hospital and ambulatory care that focuses on alerts and reminders(10).

The lessons learned from this team experience are valuable for others to also learn from and can be applied in a variety of settings. The work that we have conducted for J9 data collection is being used in other health facilities in Haiti in addition to the Maternal Center of Excellence (MCOE) in Sierra Leone. The primary lesson is that a fully integrated EMR point-of-care system eliminates the need to double-chart and improves data quality. The EMR system is mature now after numerous rounds of feedback from the J9 clinical team and software iterations. Since OpenMRS and the antenatal configuration is open source, free, and multi-lingual, it is available to all, worldwide.

The outcomes of this CQI project came about as a result of a great amount of teamwork and collaborative efforts to achieve the outcomes desired. A CQI project requires team members taking the roles of leader, facilitator, secretary, timekeeper, and members. Beyond nursing, this interdisciplinary project involved physicians, monitoring & evaluation, EMR trainers, and IT software developers. This cross-collaborative approach was critical to achieving the project goals.

Nursing implications included having a strong and dedicated nursing leadership to carry out the paper to electronic transition in addition to nursing staff motivated to improving data collection. These factors contributed to the improvement of the quality of the J9 dataset and therefore improvement in the quality of the monthly reports on patient outcomes. EMR-based Quality Improvement projects can succeed when nurses lead and are involved in the process, resulting in the success and sustainability of the outcome.

Other technical solutions to aid this transition to getting closer to 100% of data entry include a solution that has been adapted in other resource poor settings where OpenMRS is being used. Optical character recognition (OCR) software has been used to scan documents(11,25,26) which could potentially assist the staff through back entering the paper forms when the EMR is unavailable. Additionally, in Nigeria, a model of information system adoption looked at “system usability”, “effort expectancy” and “net benefits” showing significant results when systems changes are made in

terms of quality of the interface, with higher staff satisfaction and significantly influenced use(27).
Although our project was conducted in only one health facility, our experiences are reflective of what happens in a lot of low-resourced settings in terms of effectiveness of interventions that increase EMR data entry in LMIC's using OpenMRS. If this project had occurred in a much better resourced facility than typical in Haiti, then the results may not be generalizable. However, our project was set in a low income setting and is reflective of the environment, staff and other resources typically available in the country; it is for this reason that we propose that the results are more likely to be generalizable.

Limitations

LMP, Estimated Date of Delivery, and GPAL data are entered during intake at the 1st prenatal visit starting in February 2022. Elements such as family history and pregnancy history are only sporadically being entered during the first prenatal visit and these indicators can be improved upon. The first prenatal visit data were not analyzed as part of this paper as the first prenatal visit is performed prior to registration in the J9 program. Additionally, the EMR system is down on occasion and there is a back-up system of paper charts for which missing data is not currently being back-entered into the EMR.
Lessons learned on the part of the staff and organization from this experience highlight the importance of a core group of dedicated medical providers to communicate and collaborate with HIS staff who have the desire and bandwidth to take on the challenge of helping a University Hospital in Haiti make the transition from paper to electronic medical records. Without this commitment to the objective of transitioning from paper to electronic data collection, the team would not have been able to span the “digital divide”(28) and achieve the sustained results such as this team observed. Staff in clinics or hospitals in low resource settings may not have the bandwidth to even collect point-of-care electronic data therefore impacting their ability to share successes, challenges, and needs through reporting mechanisms.
Other sequelae of this scale up includes a positive subsequent influence on point-of-care data entry during first and follow-up individual Prenatal visits, GYN visits, and Family Planning visits outside of the J9 program. This data was not included in this paper but there has been significant uptake of the EMR system among providers across all outpatient women’s health services. These positive benefits seen in J9 and outpatient women’s health services, are helping to sustain the process for getting over the hump of point-of-care data entry.
It is important to note that the Women’s Health outpatient department is the first of many services in the hospital to make the transition from paper to electronic. The team has also encountered challenges in hospitalization transition such as the labor and delivery services in adopting point-of-care electronic documentation, where timing and access to quality data is even more important.
Lastly, challenges around the need for additional laptops was identified in the Ishikawa Diagram, but has not been completely addressed. The current desktop hardware system is aging; resolving procurement issues to update and sustain the EMR system is another challenge that the team has faced.

CONCLUSION

The J9 CQI project demonstrated improvement of the electronic documentation of outpatient antenatal care from 18% to 89% into the UHM EMR by J9 staff, from January to September 2021. This project was comprised of three (3) PDSA cycles, however, it was found that the most significant improvements emerged from the enhanced EMR interface for data collection (PDSA 3). This change reduced the amount of time staff spent on data entry which facilitated the transition from double entry to prioritizing the EMR for point-of-care data collection. This project also highlights the value nurses place on the importance of a stable, point-of-care system with high quality data capture that ultimately drove our transition.
This is an example of strong empowered hospital nursing leadership taking the initiative to invest time and energy into its nursing staff to improve antenatal data collection and to make the transition from paper to an electronic medical records system. Implicit in this work is the notion that the clinicians – primarily nurses in

this case, are both the lead beneficiaries (along with the patients) of timely access to high quality data as well as the ones doing all or most of the work in data collection and entry. Other beneficiaries such as hospital leadership, management, funders etc. do not directly contribute to the work but help in supporting systems, hardware etc. For this reason, involving the nursing team closely in the design and implementation of the EMR and quality improvement processes, supports the centrality of Nurses as key actors and workers.

It is important to note that as stated above, in most resource limited settings like Haiti, access to electronic data collection is limited or incomplete and often duplicate and overlapping; increasing the workload for health workers(12,18). High quality, timely, complete data entry in the EMR supports clinical care improvement, reduces the need for duplicate data collection and the effort on reporting tasks. The ultimate success of this project was due to the CQI project leadership, nursing leadership, and the diverse skill sets of the members of the project, all of whom impacted the long-term sustainability of the results and on the quality of documentation in the outpatient women's health services at UHM. These results can in turn improve patient quality of care. The experiences that this quality improvement project team encountered can contribute to the literature through the strategy undertaken by this team to improve and sustain electronic data collection as well as the transition from paper to electronic documentation within a burgeoning health care system.

DECLARATIONS

Competing Interests

The authors declare that they have no competing interests

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Authors Contributions

TJ was the Quality Improvement project leader, proposed and supervised the project; MCJB analyzed the data and wrote the main content in the report; EB and TJ provided main content edits. All authors read and approved the final manuscript.

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Data Availability

The de-identified datasets that were generated from the UHM EMR in Haiti and analyzed during the study are not publicly available. All relevant data are within the manuscript and its Supporting Information files.

Artificial Intelligence

The author(s) attest that no use of generative artificial intelligence (AI) technology in the generation of text, figures, or other informational content of this manuscript.

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Figures

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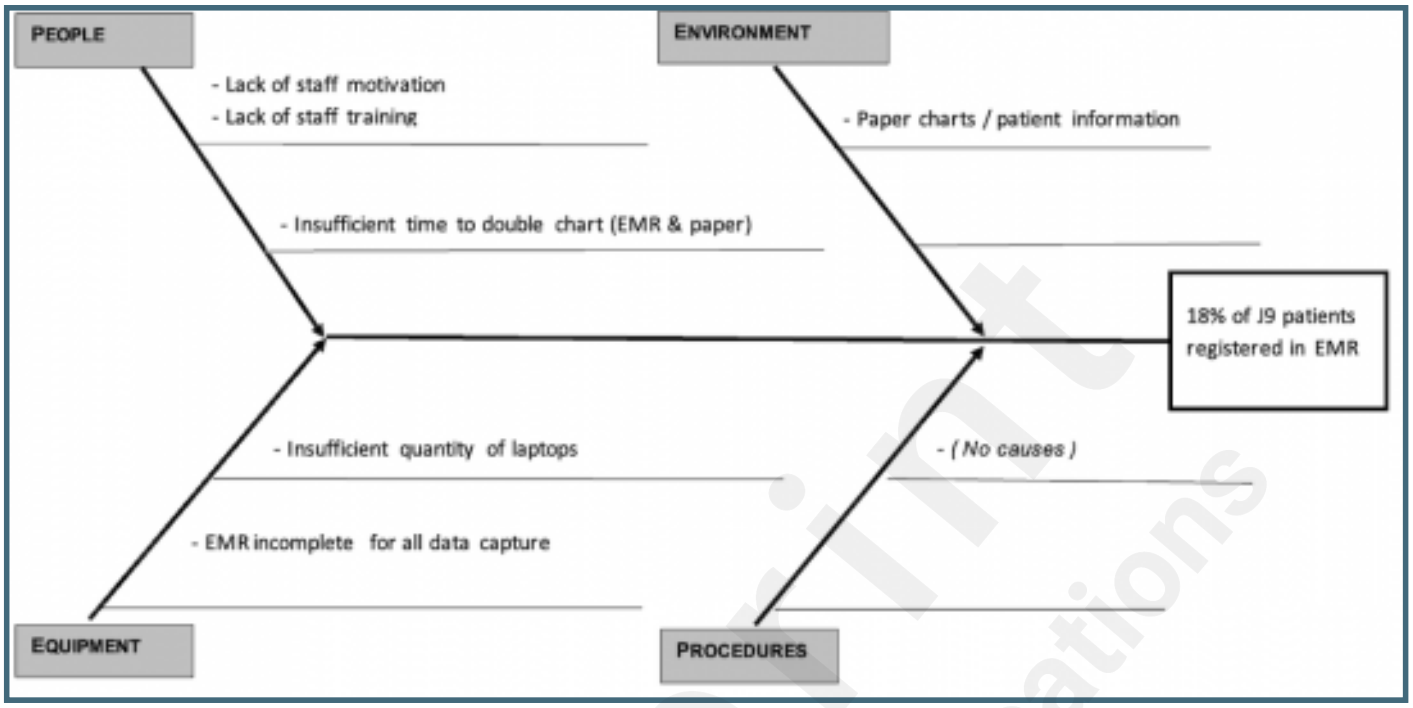
Ishikawa Diagram of Cause and Effect at University Hospital Mirebalais (Haiti) maternal health antenatal EMR data entry quality improvement project (2020-2022).



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Pareto Diagram of maternal health antenatal EMR data entry quality improvement project at University Hospital Mirebalais (Haiti) (2020-2022).

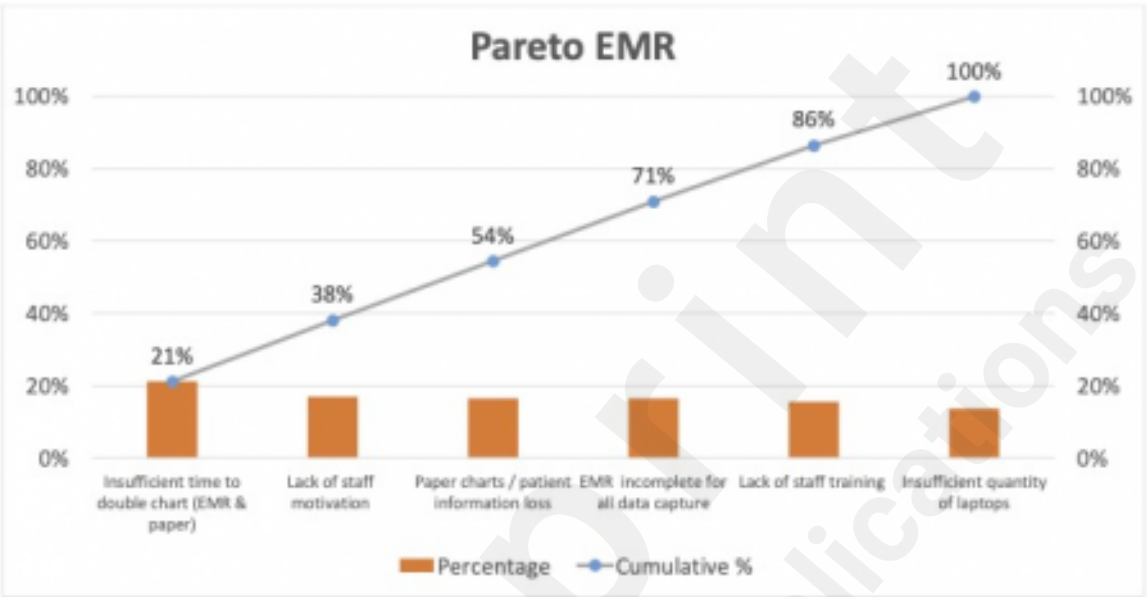

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Table 1: PDSA Cycles of improvement at University Hospital Mirebalais (Haiti) maternal health antenatal EMR data entry quality improvement project (2020-2022).

	PLAN	DO	STUDY	ACT
December 2020: 1st PDSA	Addressed the problem of "Lack of staff motivation" to enter data into the EMR	Encouraged the J9 providers: 4 Nurses and 1 Nurse Midwife to enter the patient prenatal information at point-of-care, directly into the EMR system instead of onto the paper forms. Inaccessibility of the EMR system due to connectivity issues was a primary concern expressed; decision to use paper forms only when the system was down resolved this issue.	This cycle resulted in an increase from 15% LMP to 20% data entry in February 2021 (see Figure 3).	The team decided to adapt the strategy and continue with a second cycle
May 2021: 2nd PDSA	Addressed the "Lack of staff training" on the EMR usage, training held on EMR data entry for the staff	ZL based HIS team conducted an EMR specific training on May 20 – 21, 2021, for the J9 staff.	This resulted in an increase from 13% of prenatal visits in had the LMP entered May 2021, to 52% of Prenatal J9 electronic data entered in June 2021	The team decided to adapt the strategy and continue with a third cycle
April-June 2021: 3rd PDSA	Addressed the root causes "Insufficient time to Double Chart" and "Incomplete EMR platform": A team of ZL medical leadership, J9 staff, M&E and HIS staff in both Haiti and Boston worked together to address EMR issues.	A team of ZL medical leadership, J9 staff, M&E and HIS staff in Haiti and Boston worked together to address EMR issues. Weekly team meetings to ensure quality data collection.	The results of this cycle showed an average of 89% of J9 prenatal patient data entered completely in the EMR. (July 2021 – April 2022)	The strategy was adopted. The results of this 3rd PDSA have been sustained. The team continues to work without the use of paper charts, unless the electronic system is inaccessible and back-up paper forms are necessary. (See Figure 3)

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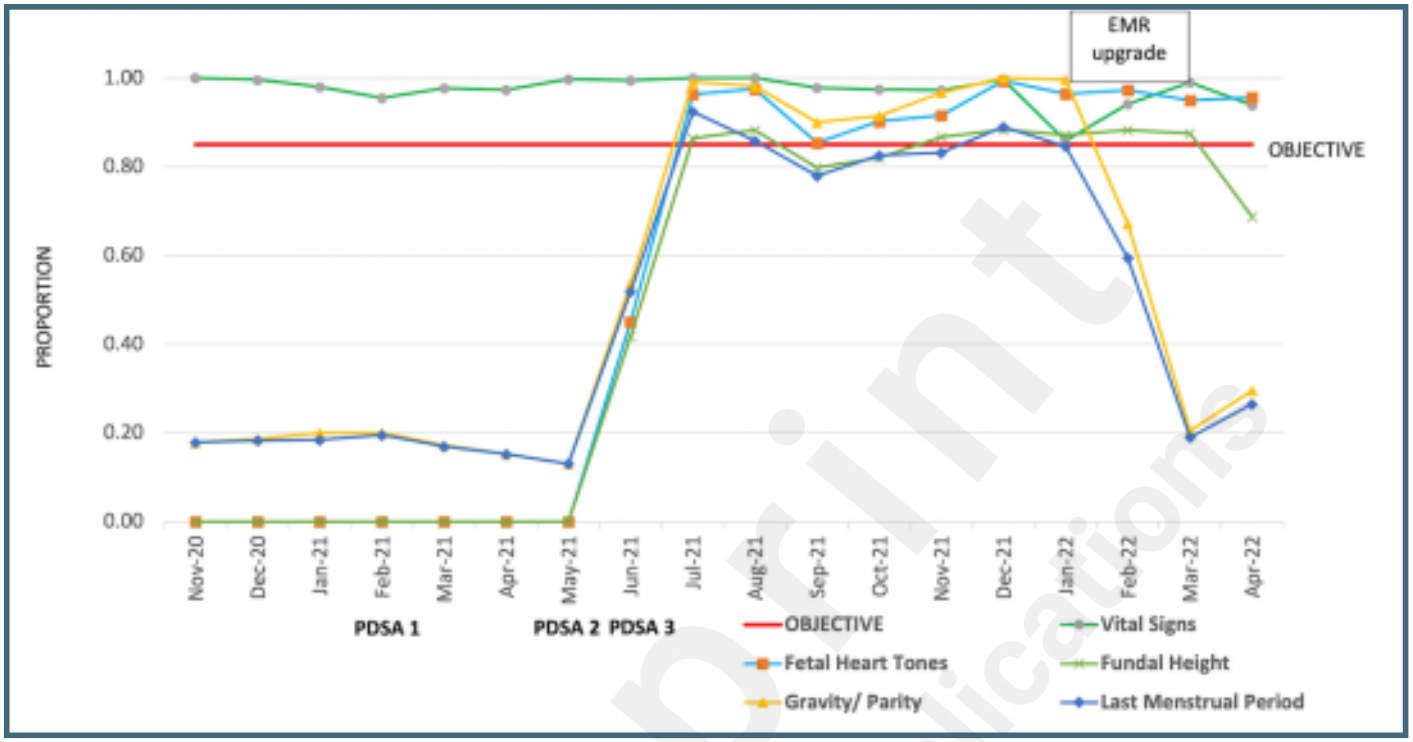
Runchart diagram showing all J9 maternal health antenatal visit results 2020-2022: University Hospital Mirebalais (Haiti), EMR quality improvement project. In February 2022, EMR system upgrade included Last Menstrual Period and Gravity/ Parity data to be only entered on the initial antenatal intake; this data was maintained throughout the current pregnancy.



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