

## EFFECT OF SPECIALTY ORIENTED HOSPITAL MANAGEMENT SYSTEM (HMS) ON QUALITY OF ELECTRONIC MEDICAL RECORDS (EMRs) IN 2 TERTIARY CARE HOSPITALS

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### ABSTRACT

**Objective:** To assess effect of “specialty oriented HMS software” on “quality of EMRs”.

**Study Design:** Comparative interventional study.

**Place and Duration of Study:** Obstetrics Out Patient Department (OPD) of Pak Emirates Military Hospital (PEMH) Rawalpindi and Combined Military Hospital (CMH) Lahore, from Apr 2015 to Mar 2018.

**Material and Methods:** The study began in 2015 with a baseline survey of quality of EMRs produced by generic HMS software in vogue. We used an observational checklist derived from hospital SOPs including 12 mandatory EMR fields. We then collaborated with IT experts to develop and implement a specialty oriented test-HMS in obstetrics OPD, PEMH. After 6 months, quality of EMRs generated by test-HMS was assessed using same method. We cross tabulated the quality of pre and post intervention EMRs. EMR quality among individual EMR fields was also compared for each software. In 2018, we assessed quality of EMRs at tertiary care hospital, a year after the official launch of customized new-HMS software in the hospital.

**Results:** Both the test-HMS and new-HMS had a statistically significant effect in improving quality of EMRs. A statistically significant variation was also observed among EMR quality of individual fields irrespective of the software being used.

**Conclusion:** Customization of HMS improves the quality of EMRs but there may be other factors effecting EMR quality besides customization of HMS. We need to Identify and address those factors to attain true benefits of HMS.

**Keywords:** Customization, Data quality, Electronic medical records, HMS.

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### INTRODUCTION

Every clinical specialty has a unique work environment with peculiar functional needs. Therefore, creating a “one size fits all” Hospital Management System (HMS) fulfilling the needs of all specialties is difficult<sup>1</sup>. Non-customized soft wares are often associated with missed patient records which adversely affect the quality of EMRs limiting their use for directing clinical, research and policy decisions<sup>2,3</sup>. Software’s adoption in primary care settings was satisfactory but in specialist OPDs, most of the patient records continued to be made on paper; Some

part of which was later entered into HMS. Overall the degree of HMS adoption corresponded to stage ‘1 of 7’ of the Health Information Management Systems Society (HIMSS) EMR adoption model<sup>4</sup>. During in-house discussions on HMS, doctors using generic HMS attributed the suboptimal adoption of HMS largely to lack of customization in the software. Hence, in 2014, HMS cell at medical directorate, General Headquarters Rawalpindi decided to replace the generic software by a specialized one, better suited to the needs of the user. It was hypothesized that customization of software would significantly improve the adoption of HMS in specialist OPDs and enhance the quality EMRs<sup>5</sup>. We sought to test this hypothesis by implementing a customized test-software in Obstetrics OPD, PEMH Rawalpindi.

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Findings of this study hold valuable lessons to guide program implementers towards successful implementation of the new HMS in 45 military hospitals and 12 x Armed Forces Medical Institutes across the country. Since HMS is the biggest IT project of Pakistan Army, its success or failure would have huge financial implications for army alongside having an appreciable impact on hospital management and patient care. But despite this fact, very limited scientific studies have been published on the dynamics of transition to EMRs. To the best of our knowledge, no trial has so far been conducted to test the effects of customization of HMS.

### **MATERIAL AND METHODS**

We conducted a comparative interventional trial at obstetrics OPD of PEMH Rawalpindi and CMH Lahore from April 2015 to March 2018. Baseline survey was conducted in April 2015 to evaluate the existing quality of EMRs generated using generic HMS software in vogue. For this purpose, we used 1680 EMRs of 140 women seeking antenatal care in Obstetrics OPD, PEMH Rawalpindi. Selection of women was done using systematic random technique and for each patient's record, 12 EMR fields were included. Twelve EMR fields represented the 12 steps of patient care process that every pregnant woman essentially underwent in accordance with the Hospital SOPs and were routinely recorded for every patient. These 12 fields included patient's particulars (ID), weight (wt), blood pressure (BP), presenting complaints (PC), history of present illness (HOPI), past obstetric, medical and surgical history, personal and drug history, trans-abdominal ultrasound (TAU) and diagnosis.

Quality of each EMR was defined in terms of its completeness and accuracy. Completeness was defined as the proportion of patient related data entered in HMS while accuracy referred to the conformance between the electronic record and the actual findings recorded on paper prior to entry in HMS<sup>6</sup>. For data collection, a structured observation checklist including above mentioned EMR fields was designed and pretested. Pros-

pective analysis of EMRs was done by observing the patient care process of 140 women from the moment a woman confirmed her visit in obstetrics OPD to receiving consultation by the obstetrician. The quality of EMR generated at each station was documented in the observational checklist. For example at the obstetric nursing station, it was noted whether patients' BP and weight were recorded in HMS (completeness) and whether the entered values coincided with those noted on paper (accuracy). The overall completeness and accuracy of EMRs we calculated by adding the completeness and accuracy scores of 12 fields.

Once the baseline survey was completed, we collaborated with IT experts to develop and implement a specialty oriented module of HMS for obstetrics. The customized test-HMS was designed based on feedback received from all obstetricians practicing in PEMH Rawalpindi in May 2015 (n=36). Six months after implementation of test-HMS, quality of EMRs generated using test-HMS was again assessed using same tool. We employed chi square test at a significance level of 0.05 to evaluate the difference between the quality of pre and post intervention EMRs. We used Microsoft excel 2006 and SPSS version 19 for data analysis. To verify the results of our pilot trial and to enhance generalizability, we conducted a cross-sectional assessment of EMR quality at CMH Lahore in March 2018, a year after implementation of the actual customized HMS software (new-HMS) and compared the results with the findings of our pilot project.

### **RESULTS**

Baseline survey done on generic HMS software in 2015 showed that only 33% of patient related information was being entered in HMS with 28% being entered accurately. Introduction of customized test-HMS improved the completeness of EMRs from 33% to 42% which was statistically significant ( $p < 0.001$ ). Similarly, the accuracy of EMRs increased from 28% to 32% which was also statistically significant ( $p = 0.003$ ). Cross tabulation is shown in table-I & II.

Comparison of EMR completeness and accuracy among individual HMS fields separately for generic and test HMS also found statistically significant variation. For example, comparing the EMR quality among individual fields for generic software showed that ID and BP records had a significantly better quality than that of past obstetric history (P.Obs.H) or TAU. For test-HMS as well, EMRs of diagnosis were superior in quality to that of past obstetric history (P.Obs.H) as evidenced by cross tabulation in table-III.

Comparison of quality of EMRs generated using generic HMS at PEMH Rawalpindi in 2015 with those produced by the new-HMS at CMH Lahore in 2018 showed a significant

improvement in the completeness and accuracy of EMRs as shown in table-VI. as the sole source of patient data in military hospitals in question<sup>9</sup>. Hence till HMS is well established in military hospitals and the quality of HMS generated records has been verified, it may be appropriate to keep recording the patient information on paper as well otherwise a significant amount of patient related data may be lost.

**Table-I: Effect of test-HMS on completeness of EMRs at obstetrics OPD, MH Rawalpindi, 2015.**

HMS used	EMRs Evaluated (n)	Complete EMRs No (%)	Incomplete EMRs No (%)
Generic	1680	547 (32.6)	1133 (67.4)
Customized (test)	1680	707 (42.08)	973 (57.92)

**Table-II: Effect of test-HMS on accuracy of EMRs at obstetrics OPD, MH Rawalpindi, 2015.**

HMS used	EMRs evaluated (n)	Accurate EMRs No (%)	Inaccurate EMRs No (%)
Generic	1680	467 (27.79)	1213 (72.20)
Customized (test)	1680	546 (32.5)	1134 (67.5)

**Table-III: Comparison of completeness and accuracy of EMRs between BP and past obstetric history EMR fields for Generic HMS at obstetrics OPD, MH Rawalpindi, 2015.**

EMR quality parameter	EMRs evaluated(n)	BP EMRs No (%)	P.Obs.H EMRs No (%)	p-value
Completeness	140	89 (63.57)	14 (10)	<0.001
Accuracy	140	74 (52.85)	11 (7.85)	<0.001

as the sole source of patient data in military hospitals in question<sup>9</sup>. Hence till HMS is well established in military hospitals and the quality of HMS generated records has been verified, it may be appropriate to keep recording the patient information on paper as well otherwise a significant amount of patient related data may be lost.

## DISCUSSION

The ability of any HMS in improving patient care, research and health planning is ultimately dependent on the quality of information being generated by it<sup>7</sup>. Baseline survey done on generic HMS software in 2015 showed that only 33% of patient related information was being entered in HMS with 28% being entered accurately. Although the values improved significantly after introduction of a customized software; Yet they are still well below the target i.e. 90-95%. These values are also lower than the patient HMS atten-

Transition to EMR in clinical settings is often characterized by incomplete adoption and has been studied extensively<sup>10</sup>. According to the available literature a number of personal, organizational, technical, financial, and legal factors determine the success of EMR adoption<sup>11</sup>. Among these, technical and individual factors (including

user's inertia) play a greater role<sup>12</sup>. Informal discussion with various stakeholders during the conduct of this study revealed some of these factors relevant to our setting as well. For example, the users were not confident with the training which was offered to them for using the new software which ranged from no training at all to a maximum of 3 days of classroom teaching /demonstration. User training is recognized as a vital element in successful EMR adoption<sup>13</sup>. Investing in the training of users including simulation training and introduction of EMR in standard medical education curricula may prove beneficial<sup>14,15</sup>. Successful EMR training models

ins-tance patient ID, weight, blood pressure and diagnosis etc were being recorded with significantly higher accuracy and completeness irrespective of the software used. This implies that other factors were also in play effecting the quality of data besides the type of software being used. For example "who" entered that data could make a difference. In our study, patient ID was being entered by staff dedicated and trained for this purpose and showed significantly better quality. Also, weight and blood pressure was entered by an obstetric nurse whose sole task was to record weight and blood pressure and again showed a better quality. Hence, the quality of

**Table-IV: Comparison of completeness and accuracy of EMRs between ID and TAU EMR fields for generic HMS at Obstetrics OPD, MH Rawalpindi, 2015.**

EMR quality parameter	EMRs evaluated(n)	ID EMRs No (%)	TAUEMRs No (%)	p-value
Completeness	140	139 (99.28)	9 (6.42)	<0.001
Accuracy	140	135 (96.42)	1 (.7)	<0.001

**Table-V: Comparison of completeness and accuracy of EMRs between Diagnosis and past Obstetric history EMR fields for test-HMS at obstetrics OPD, MH Rawalpindi, 2015.**

EMR quality parameter	EMRs evaluated(n)	Diagnosis EMRs No (%)	P.Obs.H EMRs No (%)	p-value
Completeness	140	119 (85)	14 (10)	<0.001
Accuracy	140	95 (67.88)	16 (11.42)	<0.001

**Table-VI: Comparison of quality of EMRs generated using Generic HMS at MH Rawalpindi and new HMS, CMH Lahore, 2018.**

EMR quality parameter	Generic HMS (n=1680) No (%)	New HMS (n=840) No (%)	p-value
Completeness	547 (32.6)	310 (36.90)	0.03
Accuracy	467 (27.8)	396(47.14)	<0.001

like Benner's novice to expert model and Lowe's five key principles may be referred to for developing effective teaching methodology in this regard<sup>16</sup>. Another factor hindering the desired use of HMS despite provision of the demanded software amendments could be the enormous patient workload in our OPDs which is known to correlate negatively with EMR adoption<sup>17</sup>. Offering incentives has also shown promise for boosting EMR adoption<sup>18</sup>.

The difference between the completeness and accuracy of individual HMS fields also gives some idea about additional factors affecting HMS adoption in our OPDs. Some variables for

records can improve if dedicated and trained data entry operators are involved. The financial impact of such an intervention would however need to be taken in account. Also, the obstetricians were more likely to record presenting complaints and diagnosis compared to other variables like past obstetric history which was otherwise recorded very carefully in paper records. Discussion with obstetricians revealed that filling presenting complaints' and diagnosis' fields was a mandatory requirement by the software and record would not close until the mandatory fields were filled. So, making alterations in the software which necessitate a mini-

imum level of information to be entered can potentially improve data quality.

## CONCLUSION

The results of this study help predict the outcome of the newer version of HMS which is expected to be launched in 45 military hospitals and 12 x Armed Forces Medical Institutes across the country from 2018 to 2020. Replacing HMS software alone cannot be expected to have a significant impact. There is a need for focused research to understand the practical barriers to HMS implementation in military hospitals. Successful adoption of HMS relies on devising evidence based strategies to overcome those barriers and allocating substantial resources (time, money and manpower) to accomplish those strategies. A small proportion of capital if allocated to these complimentary measures, may have a tremendous impact on enhancing the utilization of huge investments already made on the HMS project.

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## CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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