



## Application of Electronic Medical Record at Intensive Care Unit in Maternity and Children Hospital

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### Abstract

**Background:** Electronic medical record implementation within the PICU to measure the system effectiveness with analysis the user's attitude toward the system use based on TAM3. **Methods:** A controlled before and after study, started from 29<sup>th</sup> Sep 2016 to 11<sup>th</sup> May 2017, were conducted in the PICU of Children Hospital. A convenience (probability) sample of pediatric patients was selected before and after EMR use. And a purposive (non-probability) sample of PICU staff was selected after 3 months of EMR application. The data were gathered from sheets in the before and after period by stopwatch and an excel spreadsheet tool. In addition to, the electronic questionnaire developed based on TAM3 by using (google forms) used to collect data from the respondent survey, for the period from (14<sup>th</sup> March - 30<sup>th</sup> April 2017). Data were analyzed using SPSS®, through applying descriptive and inferential analysis as; frequency, percentage, mean, Cronbach's alpha test, and paired-samples T test. **Results:** The results were the documentation time was faster using electronic recording, (10.25 min  $\pm$ 0.38sc vs 23.9 min  $\pm$ 0.43 sc;  $p < 0.001$ ). And documentation completeness was enhanced significantly after application. All PICU users enrolling in the afterward time accomplished analyses were having highly scored of attitude toward EMR system use. **Conclusion:** The EMR system implemented in the PICU overall succeed, electronic charting was faster, as well as the documentation completion recording was significantly improved. The healthcare members were having a positive attitude toward adoption of the system.

**Keywords:** Documentation completeness, EMR, Implementation process, PICU, Technology acceptance model 3, Time.

### Introduction

In the last decade, information technology has played a major role in the healthcare field. The Electronic Medical Record (EMR) is a system that allows info, which includes patient information, clinical history, and status of health, to be automatically gained, stored and managed [1].

The paper-based patient records are often disorganized, unreadable, and site-linked, making ongoing data evaluation and integration time-consuming and ineffective. In addition to, medical errors instantly are the third leading death causes in the U.S.[2] The system application is pronounced to enhance the efficiency and effectiveness of hospitals and help reduce organizational costs[3]. A hospital of 200-beds should require spending more than \$7.2 million to carry out the EMR system, hospitals are expected to save \$141.9 billion to \$369.9 billion annually from an EMR application,

due to improved performance and decreased reporting errors, whereas growth within the advantages[4].

In 2012, 44% of U.S healthcare specialists used a few shapes of EMRs. The EMR rate of adoption in Japan in 2011 changed into 51.5% in massive hospitals. In China, they report that about 69.3% of hospitals have their clinicians using EMRs to setting orders [5]. Nursing plays an essential part in patient care services and health care organizations; identify nurses as the two coordinators and providers of these helps [5]. Nurses interact more with EMR applied at the Pediatric Intensive Care Unit (PICU) than other health professionals as their natural duty [6].

The EMRs challenges in any critical care unit are expanded by the everyday utilities at this unit [6]. In particular, it is vital to the

pediatric EMR function to offer care which is accessible, family-focused, relentless, complete, prepared, sympathetic, and culturally effective [7]. This paper aimed to identify the System Development Life Cycle (SDLC) process of including the Windows 8 built EMRs-software at the PICU. Time spent calculating, evaluating of documentation completeness in the before-after application period. Also, evaluate the factors affecting the EMR acceptance by PICU staff, according to the proposed study model, based on the Technology Acceptance Model3 (TAM3).

## Method

A controlled before and after design was used for the study purpose. In the PICU of the 223-bed Maternity and Children Hospital. A convenience (probability) sample (N=120) of pediatric patients admitted to the PICU before EMR use (n=60) and after EMR (n=60). And a purposive (non-probability) sample of (n=30) PICU staff distributed as (23 males-7 females) was selected after 3 months of EMR use. Implementation Process identified as the SDLC consists of "selecting, planning, designing, building, testing, implementing and maintaining an EMR within a healthcare organization." [8] The researcher offers the EMR Project timeline over the 2-year period with milestones presented in each phase. Appendix (A) depicts the 6-month timeline during the 2-year (2016-2017).

The Medical Records System (EMR NEXT™, version 1.x, Unison Care Corp., Virginia, USA) app for Windows 8 implementation within PICU. The data were gathered from sheets by stopwatch with an excel spreadsheet tool designed to specify the time recording on paper and on the EMR, as well as, the data completeness of the recording tasks on paper charts and electronic charts were collected by embedding their subcomponents into an excel spreadsheet tool designed to collect data to measure the system effectiveness.

Lastly, the electronic questionnaire developed based on TAM3 by using (google forms) was used to collect data from respondent survey through self-administration after implementation by sending the link via (E-mail, social media like Facebook or Viber) to evaluate their acceptance, for the period (14<sup>th</sup> March - 30<sup>th</sup>

April 2017). The tool for data completeness was rated at 3 Likert rating scale as never (1), partially (2), and fully (3) completed. As well, the e-questionnaire was rated at 4 Likert rating scale as strongly disagree (1), disagree (2), agree (3), and strongly agree (4). Data were analyzed using SPSS® V24, through applying descriptive and inferential analysis as; frequency, percentage, mean, standard deviation, Cronbach's alpha test, and paired-samples T test. Ethical approval was obtained from a scientific research Committee at the nursing college and governmental health department (2016/10).

## Results

The Cronbach's Alpha method was used to measure e-questionnaire reliability; the overall e-questionnaire reliability coefficient was (0.98), which is a high-reliability coefficient in such studies. The time saving is statistically significant. Before period of the EMRs was applied, total nursing and medical times for paper recording were 23.9 minutes  $\pm$ 0.43 seconds. This time was decreased by 12.44 minutes  $\pm$ 0.56 seconds in the after period.

This indicates a time saving of close to 53%. It was estimated that the total saving for the critical care unit of the hospital for one year was 10 work shifts in PICU. Also, the changes in the documentation were assessed by comparing the overall means (paired) achieved in the component of sheets using paired record's t-test. Statistical meaning was customary on ( $p < 0.05$  (2-tailed)). Completion the majority of the charting areas enhanced after the applied of the system and the results are displayed in Table (1).


The encounter sheet area ( $p=0.000 < 0.05$ ) incorporated a hard stop that prevented advancing without items completion. Two areas, (referral sheet and discharge sheet ( $p=0.030 < 0.05$ )) they were completed on 100% of EMR. However, the area with the greatly improved (general sheet ( $p=0.000 < 0.05$ )). The last sheet, history sheet ( $p=0.000 < 0.05$ ), showing a significant improvement.

As well the e-questionnaire evaluation results of PICU workers' perceived acceptance of EMRs were revealed in Table (2). The highest score factor is Actual System Use (3.5 further than 4), followed with Perceived Usefulness (3.57), Perceived Ease of Use (3.56), Satisfaction (3.46), Trust (3.41)

and Perceived Ease to Learn (3.3). Overall, EMRs for their daily documentation tasks. the PICU staff accepted with the beliefs of

**Table 1: Completion of PICU record components before and after implementation of EMR (N=120)**

Components of PICU record	Completion of paper record before (n=60)			Completion of EMR after (n=60)			p
	Never	Partial	Full	Never	Partial	Full	
General Sheet	15.3%	27.5%	57.2%	11.1%	12.7%	76.2%	0.000
History Sheet	50.0%	21.3%	28.8%	45.4%	1.3%	53.3%	0.000
Encounter Sheet <sup>a</sup>	52.0%	9.2%	38.8%	33.1%	6.6%	60.3%	0.000
Referral Sheet	0	50.0%	50.0%	0	0	100%	-
Discharge Sheet	10.0%	20.0%	70.0%	0	0	100 %	0.030

**Note:** <sup>a</sup> hard stop on these items prevented the user from the block the sheet if was never or only partially completed when clicking on this  button block that was for locking the encounter form. *P*, *p-value (sig. <0.05)*.

**Table 2: Perceived acceptance of the EMRs system by PICU workers' in terms of 22 questions (N=30)**

Questions	Strongly Agree	Agree	Disagree	Strongly Disagree	M	SD	Rank
	4	3	2	1			
	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>			
<u>Usefulness</u>							
1. More convenient to operate	18 (60.0)	12 (40.0)	0	0	3.60	0.49	3
2. Save time and get jobs done sooner	15 (50.0)	14 (46.7)	1 (3.3)	0	3.47	0.57	
3. Can easily extract a summary of old record for different purposes	18 (60.0)	12 (40.0)	0	0	3.60	0.49	3
4. More convenient for child care	19 (63.3)	10 (33.3)	1 (3.3)	0	3.60	0.56	3
5. Better fit care needs	19 (63.3)	9 (30.0)	2 (6.7)	0	3.57	0.62	4
<u>Ease to use</u>							
6. The system layout is easy to understand	14 (46.7)	16 (53.3)	0	0	3.47	0.50	8
7. The system makes documentation simpler	19 (63.3)	11 (36.7)	0	0	3.63	0.49	2
8. It is easy to navigate through system functions	15 (50.0)	15(50.0)	0	0	3.50	0.50	6
9. It is easy to find records and patient documentation within the system	20 (66.7)	10 (33.3)	0	0	3.67	0.47	1
10. Overall, this system is easy to use	16 (53.3)	14 (46.7)	0	0	3.53	0.50	5
<u>Ease to learn</u>							
11. I can quickly learn how to use the system	11 (36.7)	19 (63.3)	0	0	3.37	0.49	10
12. I can easy use the system	11 (36.7)	19 (63.3)	0	0	3.37	0.49	10
13. I can become skillful quickly	11 (36.7)	18 (60.0)	1 (3.3)	0	3.33	0.54	11
<u>Actual System Use</u>							
14. You will use the EMR system on a regular basis in the future	18 (60.0)	12 (40.0)	0	0	3.47	0.49	3
15. I highly recommend others to use EMR System	16 (53.3)	14 (46.7)	0	0	3.4	0.50	5
<u>Satisfaction</u>							
16. I feel this system is what I need	16 (53.3)	13 (43.3)	1 (3.3)	0	3.50	0.57	6
17. I like this system very much	12 (40.0)	18 (60.0)	0	0	3.40	0.49	8
18. I am very satisfied with the convenience of using the system	14 (46.7)	16 (53.3)	0	0	3.47	0.50	9
<u>Trust</u>							
19. It will be difficult to make an administration error if I use this system	13 (43.3)	15 (50.0)	2 (6.7)	0	3.37	0.61	6
20. The use of the system increases the confidence of other healthcare professionals in the information that I registered in the system the system	12 (40.0)	17 (56.7)	1 (3.3)	0	3.37	0.55	9
21. Using the system helps improve my skills in communicating with the ICU staff	13 (43.3)	16 (53.3)	1 (3.3)	0	3.40	0.56	10
22. Feel well to use system in child care	16 (53.3)	13 (43.3)	1 (3.3)	0	3.50	0.57	10
Overall	336(50.9)	313(47.4)	11(1.7)	0	3.48	0.52	

M, mean; SD, standard deviation

## Discussion

Following the EMR NEXT™ use the whole time spent on records of nursing and medical care decreased by 12.44 min ±0.56 sc. The results are broadly consistent with a systematic analysis by Chaudhry et al.[9]

recognized 2 articles showing a reduction in registering time for nursing records on inpatient ICU areas utilizing electronic registering (Wong et al.[10] and Pierpont and Thilgen11). These findings concur with another study presented by Pabsit et al. [12]

who stated that the nursing documentation time diminished by twenty min/shift. Our present result did not support by other before-after controlled study was carried out by Perry et al. [13] at the Ottawa Hospital. Were found, the templet-based electronic records in that study were significantly more time taking  $9.6 \pm 5.9$  min to complete record than the present paper record system taking  $6.1 \pm 2.5$  min. Furthermore, documentation completeness was enhanced significantly after the EMR NEXT™ use, complete entry of all information of pediatric inpatient admission have such increased after the intervention of the EMR system as shown in Table (1).

This finding was similar to the pre-test/post-test time series result study was conducted by Don Kraug et al.[14] were found that, on post-test two, that info is noticed become further complete, inclusive, also more reliable than on the pretest. Finally, still, the researcher has found no studies assessing factors influencing the Pediatric ICU nurse

and health care provider's viewpoints toward the EMRs. Overall, this study found that the PICU users have a positive perception about the application of the EMR NEXT™ as shown in Table 2. Our findings are in line with a study on 70 physicians, which were reported by Alipour et al. [15] who found that an attitude of physicians to EHR system acceptance was verified in optimum point. Generally, the project was successful. As the study has demonstrated that applying the EMR NEXT™ system as a nursing and medical recording method in PICU to improve the documentation was statistically significant, electronic charting was faster as well as the documentation completion recording was significantly improved. And the users have a positive attitude toward the system use.

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### Appendix A: Electronic Medical Record Project TimeLine

Each of the system development life cycle stages is presented along with a projected duration of time (in months and days) to complete each milestone.



