

# ADOPTION OF CLOSE-LOOP MEDICATION ADMINISTRATION SYSTEM TECHNOLOGY BY NURSES TO REDUCE MEDICATION ERROR INCIDENTS

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## **Abstract**

**Background:** Medication errors are one of the targets in patient safety goals that can be prevented, thereby reducing events that are harmful to patients. The use of Electronic Medication Records with the Closed Loop Medicines Administration (CLMA) technique is known as an effort to reduce the occurrence of medication errors.

**Objective:** This study aims to identify the impact of CLMA implementation on medication error incidents and nurses' perspective towards CLMA system at inpatient units.

**Method:** This research is quantitative research using two approaches. The correlational approaches are carried out through three phases (pre-intervention, intervention, and post-intervention periods) data collected by questionnaires and secondary data. The observational approach using time motion study on 28 nurses in the intervention group, and 22 nurses in the control group.

**Results:** There was a decrease in the number of medication errors after using CLMA (p value 0.000). CLMA can reduce double-check time (p value 0.000) and drug administration time (p value 0.000). Nurses' perceptions of CLMA are that the technique is positive (89.3%), easy to use (60.7%), increases productivity (67.9%) and can improve the culture of safety (71.4%). Barriers experienced by nurses were limited facilities (85.7%), networks (60.7), and nursing burdens related to patients and medicines (23%)

**Conclusion:** The implementation of CLMA has a positive impact in reducing the incidence of medication errors, and can improve the quality of nursing practice.

**Keywords:** Closed Loop Medicines Administration, Medication Errors

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## **BACKGROUND**

The Global Patient Safety Action Plan 2022 states that medication errors are a contributor to injury, harm, and death for patients. Medication errors are part of the patient safety goal, which is the focus of quality and effective healthcare delivery. Medication errors are events that can be prevented by identifying the causes of inappropriate drug use or harm to patients within the control of health care professionals and patients or consumers (WHO, 2022). The medication errors has increased in 2023 in July 2023 in RS X. Furthermore, the organization introduced Closed Loop Medicines Administration (CLMA) as a recommended system technology to reduce medication errors rate.

Pharmacy department at RS X Tangerang created CLMA system technology prototype integrated into the Electronic Medication Report (EMR). The CLMA technology system enables clinicians to electronically enter a medication order in the EMR, which integrated with the pharmacy information

system, but also connected to nurse. Recommendations for using CLMA as an effort to reduce medication errors and at the same time identify errors or near missed or sentinel events (Burkoski, et.al, 2019). This study was conducted to identify the impact of CLMA implementation on the incidence of medication errors in inpatient units.

The CLMA system technology provides end-to-end, safe and efficient electronic medication management system across the full cycle of the medication ordering to administration processes. Nurses adopt the CLMA technology system to reduce medication errors. Nurses used CLMA to receive medication from the pharmacy, make medication time arrangements, do an independent double-check, and administer medication to the patient. In implementing CLMA in a nursing practice environment, nurses face many challenges, obstacles, and limitations. Implementing CLMA in a nursing practice faced many challenges, obstacles, and limitations. Based on this phenomenon, this study was conducted to identify the effective implementation of CLMA system technology in reducing medication errors.

## **METHODS**

This research used quantitative research, with direct observation study. Sampling technique in this research is a total sampling. The sample in this study was a total of 28 nurses in the intervention group (CLMA system) and 22 nurses in the control group (conventional methods). After obtaining research permission from the Research Ethics Committee of Siloam Hospitals Lippo Village and the Hospital Director of Siloam Hospitals Lippo Village, this study was conducted for July- December 2023 at three inpatient units

The data collection uses a questionnaire from 28 perspective of nurses as users of the CLMA system technology in two inpatient wards (Siloam and Samaria). This questionnaire consists of 21 questions containing favorable and unfavorable statements that are included on a Likert scale. This questionnaire has been tested for validity and reliability with a Cronbach's alpha of 0.722–0.828.

This research also compares the CLMA system technology of administering medication in the Siloam and Samaria units compared to conventional system of administering medication in the Carmel unit. The observation data collected through time motion study for measurements of nurses in three inpatient wards.

The flow of drug administration through CLMA starts with the doctor in charge of the patient placing a drug order at CLMA. If the patient has a history of food allergies, a notification will automatically appear to inform the DPJP when the order is placed. This order will automatically go to the pharmacy section, where the pharmacist will review and verify the incoming order. Pharmacists provide appropriate medicines with barcode labels so they can be scanned when administering the

medicine. The medication is then received by the nurse by checking compliance with the medication order and arranging the administration time. The nurse will prepare the medication before going to the patient by double-checking with other nurses in accordance with the provisions for administering medication using the five correct methods and scanning the medication label barcode. Nurses have a consistently clear and complete medication order from which they can determine its appropriateness before administration to the patient. When visiting the patient, the nurse will scan the name bracelet and drug barcode to identify drug administration. Medication that has been given will be recorded automatically and computerized. Next, the nurse documents medication administration in the Electronic Medication Report (EMR).

Figure 1: The schematic line of the process for the CLMA system



## RESULT

The results of this research study show the characteristics of nurses who implemented the CLMA system at Siloam and Samaria ward in Siloam Hospitals Lippo Village

**Table 1: The characteristics of Nurse's perspective towards CLMA system in Samaria and Siloam unit period July-December 2023 (N:28)**

Variable	Frequency (%)
<b>Aged</b>	
17-25 year	8 (28.6)
26-34 year	14 (50)
35-43 year	6 (21.4)
<b>Sex</b>	
Male	0 (0)
Female	28 (100)
<b>Level of Education</b>	
Diploma	5 (17.9)
Bachelor	23 (82.1)
<b>Work experience</b>	
< 1 year	1 (3.6)
1-5 year	12 (42.9)
6-10 year	7 (25)
>10 year	8 (28.6)
<b>Nurses who received CLMA socialization</b>	
No	3 (10.7)
Yes	25 (89.3)
<b>Nurse perspective towards CLMA system</b>	
<b>1. Easy to apply</b>	
Positive	17 (60.7)
Negative	11 (39.3)
<b>2. Supporting work productivity</b>	
Positive	19 (67.9)
Negative	9 (32.1)
<b>3. Support the patient safety (patient identification, Medication error)</b>	
Positive	20 (71.4)
Negative	8 (28.6)
<b>Barriers towards CLMA system</b>	
<b>1. Related to facility</b>	
Yes	4 (14.3)
No	24 (85.7)
<b>2. Related to network</b>	
Yes	17 (60.7)
No	11 (39.3)
<b>3. Related to Patient and or Medicine load</b>	
Yes	5 (17.9)

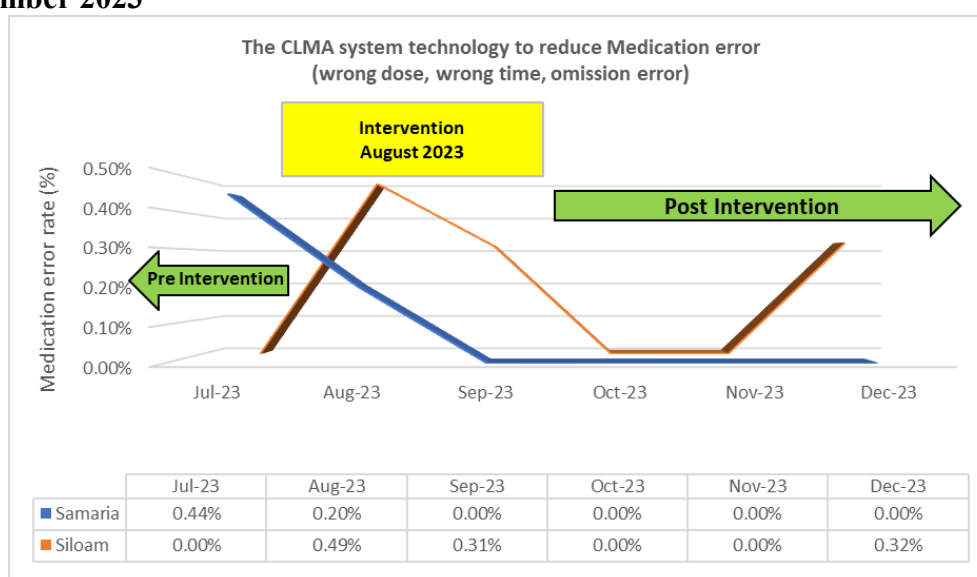
No	23 (82.1)
<b>Nurse Expectation towards CLMA system</b>	
Positive	25 (89.3)
Negative	3 (10.7)

Table 2: The time motions of Medication Administration Process by Nurse in Siloam, Samaria, and Carmel ward at Siloam Hospitals Lippo Village (N:50)

Variable	Frequency (%) / (Mean ± SD, 95%CI: Min-Max)	p-value (Mann-Whitney U)
<b>Verification of Medication/ double check process (minutes)</b>		
CLMA system	5.59 ±12.897 (0.68-10.49)	0.000
Conventional methods	53.77 ± 26.204 (42.15-65.39)	
<b>Medication Administration (minutes)</b>		
CLMA system	2.93 ± 6.665 (0.40-5.47)	0.000
Conventional methods	48.77 ± 25.766 (37.35-60.20)	

Table 2, shows the results of the mean difference in the moment of drug administration between units that have implemented the CLMA system,  $2.93 \pm 6,665$  (95% CI: 0.40-5.47) minutes, while in units that still use conventional methods, it is  $48.77 \pm 25,766$  (95% CI: 37.35- 60.20) minutes with a p-value of 0.000. This proves that the CLMA system supports time efficiency during drug administration procedures.

**Graphic 1: Medication error rate in medical surgical inpatient ward period July–December 2023**



The graph showed that the adoption of CLMA system technology by nurses in Samaria and Siloam succeeded in reducing the medication error (wrong dose, wrong time, omission error) rate. The medication error rate decreased from 0.44%-0.49% before intervention (in July 2023) to 0%-0.32% incidence after intervention (in September until December 2023).

## **DISCUSSION**

The CLMA system technology has a proactive approach to reducing medication errors through the process of enhanced medication by performing barcodes several times. The adoption of these system technologies in inpatient ward will improve safety, in particular for nurses, who are the predominant clinicians administering medications to patients. Nurses, as users of the CLMA system, adopt a technology system which is not only a development transformation process but also an attitude transformation process as a form of clinical improvement by reducing the number of medication errors (wrong dose, wrong time and omission errors). In line as the result of this research, The CLMA to improving patient safety by preventing potential medication administration error alert such as administration time, order type, medication route, the number of medication doses administered, nurse's employment duration, and working schedule (Hwang, et al., 2016).

The medicine verification time for carrying out the double-check process shows a significant difference (p-value 0.000). The verification time of conventional methods takes 53.77 minutes, while in the CLMA system technology only takes 5.59 minutes. Likewise, drug administration time was reduced from 48.77 minutes in conventional method to 2.93 minutes in CLMA system technology with a p-value of 0.000. The results of this research study are in line with previous research studies, stated that electronic medication has an impact on work productivity through time efficiency and also reduces medication errors (Gates, et al., 2021).

Nurses have positive expectations of the electronic medication transformation process (89.3%). This study demonstrated that most nurses state that the CLMA system technology is easy to apply (60.7%), supports work productivity (67.9%), and supports patient safety (71.4%). Achieving this expectation has the potential to be more efficient and more useful than conventional methods (manual documentation). The results of this research study are in line with Dabliz, et al. (2021), finding that nurses' experience in

adopting the "best" technology system can influence work productivity and expectations towards the CLMA system.

## CONCLUSION

This study has proven that the implementation of the CLMA system has a significant impact on the nurses professional practice by serving as a systematic safety net in medication administration and assisting nurses in preventing medication errors (especially wrong dose, wrong time, and omission errors). Nurses show positive expectations regarding the presence of a CLMA technology system that is more efficient and useful. Furthermore, it is necessary to develop a CLMA system between the system user group and the system development team so that a more standardized and proper system can be achieved in order to ensure patient safety and minimize the chances of normalized deviance occurring by nurses in the future.

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