Influence of Nurses Handover Styles on Selected Patient Safety Indicators

Warda Elbastawisy Elbastawisy Ahmed [(1)], Samah Faisal Fakhry[(2)], Fawzia Mohamed Badran [(3)]

[(1)]B.Sc.in Nursing Administration,[(2)]Professor of Nursing Administration,[(3)]Assistant Professor of Nursing Administration-Faculty of Nursing, Ain Shams University-Cairo-Egypt.

Abstract

Background: An accurate handover of clinical information was of great importance to continuity and safety of care. If clinically relevant information was not shared accurately and in a timely manner it may lead to adverse events, delays in treatment and diagnosis, inappropriate treatment and omission of care. **Aims:** This study aimed to examine the influence of the three different nurses handover styles on select patient safety indicators**. Design:** A comparative record-based prospective design was used to carry out this study. **Subject and Method:** The subjects of this study consist of 130 staff nurses and 6 head nurses at the critical care units of General Mahalla Hospital that affiliated to Ministry of Health **Tools** Data for this study were collected using three tools, namely, Interview questionnaire for head nurses, an observation checklist (for oral and bedside handover) an audit checklist (for written and bedside handover), and a data abstraction form for the patient safety indicators **Results:** The staff nurses in the oral group (60%) had adequate application of handover process compared to (87%)of those in the written group and (95.5%) in the bedside group. the most adequate practice of head nurses was in the bedside group (100%) and lowest in the oral group (33.3%). **Conclusion:** The bedside and written handover styles are better than the oral style in terms of patient safety. **Recommendations:** The bedside nursing handover style should be the style of choice to be applied whenever possible, Nurses should have regular training in process of handover. Important areas for future research include developing a minimum dataset requirement for handover and the design and development of technological solutions to improve the quality, standardization, and efficiency of handover data.

Keywords: Nursing handover, Handover styles, Patient safety indicators.

Introduction:

Safe care is a basic patient right patient and an obligation of health care professionals and organizations. However, potentially preventable adverse events during hospital care, however, are currently common causes of mortality and serious morbidities for patients globally. Safety improvements has thus been a real challenge to health care organizations over the last two decades **(Braaf et al., 2015; DiCuccio, 2015).**

Promoting quality care that can mitigate preventable harm associated with health care practices is fundamental in patient safety **(PS) (Miiller et al., 2018)**. Patient safety refers to absence of preventable harm to a patients while receiving health care **(World Health Organization [WHO] Patient Safety, 2016)** and is an essential part of care quality in a health care setting **(Agency for Healthcare Research and Quality, 2016).**

In nursing handover, shift nurses exchange information about nursing work as well as patient care **(Sarvestani et al., 2017),** and this has an enormous impact on nursing efficiency and on patient safety as well **(Weingart et al., 2013).** This complex, high-risk and high volume activity takes

place at least twice per day. The accuracy and completeness of this process and the related transferred information are determinants of patient safety and continuity care **(Drach-Zahavy and Hadid, 2015; Forde et al., 2018).**

According to the Joint Commission, handoffs among healthcare providers is one of the national patient safety goals **(The Joint Commission, 2017).** Moreover, the Agency on Healthcare Research and Quality (AHRQ) emphasized that handoffs effectiveness among healthcare professions is an important priority in national endeavors to promote patient safety **(AHRQ, 2016).**

Nursing handovers are aimed at coordinating care, ensuring its continuity, as well as shifting accountability and authority to incoming shift nurses, and sharing data with them **(Kitson et al., 2014).** Doing this anticipates hazards, mitigates risks related to patient clinical conditions **(Bressan et al., 2020).** Several handover styles are used by nurses in inpatient wards **(Thomas and Donohue-Porter, 2012; Bakon et al., 2017).** However, their accuracy, completeness, timeliness, and relevance have been shown to promote patient safety **(Colvin et al., 2016).**

On the other hand, failure of good communication during handover between receiver and sender can occur and may lead to serious consequences **(The Joint Commission, 2017).** Thus, similar communication failures have been associated with 1,744 patient deaths in 5 years in Harvard-affiliated hospitals **(Bailey, 2016).** Therefore, effective communication is crucial for successful handover **(Gooch, 2016).** If relevant information is not shared accurately and timely, adverse events, inappropriate treatment, and delay of care can happen, with consequent negative impact on patient outcomes **(Smeulers, 2016).**

The WHO has recommended a number of outcomes for assessment of patient safety, such as misdiagnosis and unsafe practices, leading to increased patient morbidity and mortality indices. Such patient safety outcomes are correlated to the occurrence and severity of harm it resulted on the patient **(World Health Organization [WHO], 2019).**

Significance of the study:

An accurate handover of clinical information is of great importance to continuity and safety of care. Many nursing handovers occur during a typical patient stay in a critical care hospital. These handovers are a potential primary source for adverse events if associated with incomplete or inaccurate information, and if clinically relevant information is not shared accurately and in a timely manner. Regardless the handover styles used in critical care units of Mahalla General Hospital, patient safety is jeopardized with serious adverse events, including hospital-acquired infections, decubitus ulcer, patient fall, and medication errors. The three handover styles are oral, written, and bedside. Hence, this study will be conducted to assess the different nursing handover styles used and their influence on selected patient safety indicators in order to ensure continuity of patient information for maintaining and improving patient safety and quality of patient care.

Aim of the study:

This study aim is to examine the influence of three different nurses' handover styles on selected patient safety indicators.

Research questions

- What is the influence of oral nurses' handover style on selected patient safety indicators?
- What is the influence of written nurses' handover style on selected patient safety indicators?

- What is the influence of bedsides nurses' handover styles on selected patient safety indicators?

Subjects and Methods:

I. Technical design:

The technical design for this study includes the details of its research design, setting of the study, subjects, and tools for data collection.

Research design:

A Comparative record based prospective research design was comparative studies that used data recorded in clinical records or charts data to answer clinical queries and to find out whether group (data recorded) differences in handover style adoption make a difference in important outcomes.

Setting:

The study was conducted at the critical care units of Mahalla General Hospital. This 215 bed-capacity hospital has 3 critical units, namely Medical, Surgical, and Pediatric Intensive Care Units (ICUs). The Medical, Surgical, and Pediatric ICUs were selected for the study. Each of these three units is using one of the three different handover styles, namely oral in the medical, written in the surgical, and bedside in the pediatric ICUs.

Subjects:

The data sources for the study consisted of head and staff nurses, in addition to hospital records.

Staff nurses: All the staff nurses in the three units were included in the study. These included 40 staff nurses from surgical ICUs, 40 from pediatric ICUs, and 50 from medical ICUs, for a total of 130 staff nurses.

Head nurses: All the head nurses in the three types of ICUs were included in the study. These included 6 head nurses from each type.

Hospital records: The hospital records of the corresponding ICUs during a period of 6 months from the start of the fieldwork provided the main data for the study. The information pertaining to the selected patient safety indicators was abstracted from these records and were analyzed to achieve the aim of the study.

Tools of the study:

The data of this study collected through using three tools as follows

- ***Head nurse tool:*** This interview questionnaire was designed by the researcher for head nurses. It included a section for head nurse's personal characteristics; a second section for unit characteristics; a third section was for head nurse's opinions about the handover process regarding its structure, process and outcomes.
- ***Staff nurse tool:*** This was prepared by the researcher to collect data regarding staff nurse's practice of handover. It consisted of the following parts.
  - *Part I:* This was for staff nurse's demographic data such as age, gender, qualification, experience years, training courses, handover characteristics, in addition to identification data as code number, unit, and time of observation.
  - *Part II:* This ISBAR tool developed by the researcher based on ***Bakon et al., (2017)*** to assess the actual practice of handover by the staff nurse. It was filled by observation in oral and bedside handover procedure, and by auditing in written handover.

Scoring: The items checked "done" or "documented" were scored "1", and the "not done" or "not documented" were scored "0." The items "not applicable" were not scored and were discounted from the totals. The scores of all items were summed-up and the total divided by the number of the items, giving a mean score, which was converted into a percent score. The ISBAR practice was considered adequate if the percent score is 60% or more and inadequate if less than 60%.

Part IV: This part was intended to assess the perception of efficacy of handover as reported by the staff nurse. It was adopted and translated by the researcher based on pertinent literature ***(Street et al., 2011; Demiray et al., 2018).***

Scoring: The response on the 4-point Likert scale from "never" to "always" were scored from 1 to 4 respectively. The scores of the items of each domain and for the total scale were summed-up and the total divided by the number of corresponding items, giving mean scores, which were converted into percent scores. The perception of the handover process was considered high if the percent score is 60% or more and low if less than 60%.

Abstraction form: The researcher developed this form to abstract data pertaining to the selected patient safety indicators from hospital records during the set timeframe. These included data regarding Hospital-Acquired Infections (HAIs) including surgical wound site infection (SSI), catheter-related Urinary Tract Infection (UTI), Ventilator Associated Pneumonia (VAP), and Blood Stream Infection (BSI), in addition to decubitus ulcers, patient falls, and medication errors. The data included the incidence of each of these incidents in addition to its characteristics and related patient details.

I. Operational Design:

Preparatory Phase:

The researcher reviewed current and past, local and international related literature using textbooks, articles in periodicals and journals, as well as internet search. The purpose was to acquire in-depth related theoretical knowledge. This also helped to select and develop the data collection tools and prepare for the fieldwork.

Tools validity: The tools were validated by experts. The tools were finalized based on their comments and suggestions.

Tools reliability: The reliability of the scales prepared for data collection was assessed through examining their internal consistency. They demonstrated good levels of reliability as shown by their corresponding coefficients below.

Scale	N of Items	Coefficient (Guttman split-half)
ISBAR	13	0.76
Handover process	18	0.60
Perception of handover	18	0.73

Ethical Considerations

An approval of the study protocol was obtained from the Research Ethics Committee at the Faculty of Nursing, Ain Shams University. Then the researcher met with the medical and nursing directors of the hospital to explain the purpose of the study and to obtain their permission to carry out the fieldwork and to abstract the needed information from the medical records. They were informed about their rights to refuse or withdraw at any time. They were also reassured about the anonymity of the information collected by interviewing, observation, auditing, or from the records, and that it would be used only for the purpose of scientific research. The

study procedures could not inflict any harm on participants.

Pilot Study:

A pilot study was carried out on samples of head and staff nurses representing 10% of the main study sample. It also included a sample of records covering a period of three weeks, representing about 10% of study sampling period. The purpose was to test the clarity and applicability of the tools and the time needed for filling the various forms. Necessary modifications were done according to the results of the pilot study.

Fieldwork:

After securing the official approvals to conduct the study, the researcher met the nursing director of the hospital to determine the suitable time to collect the data. The researcher then met with the head nurses of the selected ICUs, explained to them the aim and procedures of the study, and invited them.

For staff nurses, the same process of oral consent was done. Then, each staff nurse was asked to fill Part I (personal data) and Part IV (opinion about handover process) of the data collection form. Then, the oral/bedside handover processes were observed using the observation checklist (part II of the tool) for each staff nurse during the handover process for three randomly selected non-consecutive days. As for the written handover, the data were collected through auditing using Part III of the tool.

Lastly, the specified records were abstracted for the defined follow-up period using the corresponding forms. Data regarding patient safety indicators (Hospital-Acquired Infections, decubitus ulcers, patient falls, and medication errors. The data were abstracted during a 6-month follow-up period from the beginning of January to the end of June 2020.

II. Administrative Design:

An official permission to conduct the study was obtained from the director of Mahalla General Hospital and the director of Health Insurance in Mahalla al-Kubra. The researcher met the hospital director and explained the purpose and the methods of the data collection.

III. Statistical Design:

Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations and medians for quantitative variables. Qualitative categorical variables were compared using chi-square test. Whenever the expected values in one or more of the cells in a 2x2 tables was less than 5, Fisher exact test was used instead. In larger than 2x2 cross-tables, no test could be applied whenever the expected value in 10% or more of the cells was less than 5. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones. In order to identify the independent predictors of practice and opinion scores, multiple linear regression analysis was used and analysis of variance for the full regression models was done. Statistical significance was considered at p-value <0.05.

Results:

Table (1): The samples of staff nurses in the oral, written, and bedside handover study groups had almost equal median age (26.0-27.0)**.** The oral group had significantly more males (p=0.001), and diploma degree nurses (p=0.01). The median experience was highest in oral group (5.0 years) and lowest in the bedside group (3.0 years), but the difference was not statistically significant. Significantly less nurses in the written group reported

having attended training courses in handover (p=0.003).

Table (2): Demonstrates that the application of ISBAR was generally lowest in the oral group. This was specifically evident regarding both items of patient identification (p<0.001), patient stability and level of concern items of situation (p<0.001), history of presentation and relevant past medical history items of background (p<0.00l), impression of situation (p=0.005) and what was done so far (p<0.00l) items of assessment, and the recommendations item of what want to be done (p<0.00l). On the other hand, the application of ISBAR items was almost always highest in the bedside group.

Figure (1): Demonstrates that less than a half of the staff nurses (44.0%) in the oral group had adequate total application of ISBAR, compared to 92.5% in the written group and 100.0% in the bedside group. These differences were statistically significant**.**

Table (3): In total, the bedside group was significantly higher in the adequate application of the handover process conduct, teamwork, and quality (p<0.001). Conversely, the oral group was highest in the item area of circumstances (p< 0.00l).

Table (4): In total, Table 12 shows that the bedside group staff nurses had significantly lower perception of the handover interaction/support (p<0.00l). On the other hand, the oral group was lowest in the perception of the area of patient participation (p<0.001).

Table (5): Points to statistically significant relations between staff nurses' adequacy of application of ISBAR and their gender and handover type (p<0.001). It is evident that the percentages of staff nurses having adequate application were among females and those using bedside handover approach.

Table (6): Statistically significant weak positive correlations were revealed between staff nurses' scores of handover process and their age (r=0.275), and level of qualification (r=0.203).

Table (7): In total, demonstrates that the bedside handover group was highest in the structure dimension, while the written group was highest in the outcomes dimension. They were both high in the process dimension as well.

Figure (2): Overall, as displayed, the most adequate practice was in the bedside group (100.0%), and lowest in the oral group (33.3%).

Table (8): Totally, indicates that the incidence rates of medication errors whether overall or by nurses were statistically significantly lowest in the bedside handover group (p<0.001). However, the percentage of errors committed by nurses to overall errors was significantly lower in the written group.

Table (9): Concerning bed sores as an indicator of patient outcomes, the incidence was zero in the bedside group, compared to 0.72% in the oral group**.** As for patient falls, the incidence was zero in all study groups.

Table (10): The incidence of ICU acquired infections was lowest in the bedside group and highest in the oral group.

Table (1): Demographic characteristics of staff nurses in the study groups.

	Handover							
	Oral (n=50)		Written (n=40)		Bedside (n=40)		X^2	P-value
	No.	%	No.	%	No.	%		
Age:								
<30	41	82.0	31	77.5	32	80.0		
30+	9	18.0	9	22.5	8	20.0	0.28	0.87
Range	20.0-33.0		23.0-33.0		23.0-32.0			
Mean±SD	27.0±2.9		27.4±2.7		26.7±2.3		t=2.35	0.31
Median	27.0		27.0		26.0			
Gender:								
Male	17	34.0	1	2.5	7	17.5		
Female	33	66.0	39	97.5	33	82.5	14.31	0.001*
Qualification:								
Diploma	11 39	22.0	2	5.0 95.0	2	5.0		
Bachelor		78.0	38		38	95.0	8.71	0.01*
Experience								
years: <5	23	46.0	25	62.5	28	70.0		
5+	27	54.0	15	37.5	12	30.0	5.66	0.06
Range	0.0-9.0		1.0-8.0		1.0-8.0			
Mean±SD	4.8±2.2		4.1±1.7		3.9±2.0		t=5.63	0.06
Median	5.0		4.0		3.0			
Had training in:								
Nursing administration:								
No	35	70.0	22	55.0	36	65.0		
Yes	15	30.0	18	45.0	14	35.0	2.20	0.33
Handover:								
No	0	0.0	5	12.5	0	0.0		
Yes	50	100.0	35	87.5	40	100.0	11.70	0.003*

Table (2): ISBAR application as observed among staff nurses in the three study groups.

	Handover						X^2	P-value
	Oral (n = 50)		Written (n = 40)		Bedside (n = 40)			
	No.	%	No.	%	No.	%		
IDENTIFY PATIENT								
• Full Name (4)	19	38.0	35	87.5	37	92.5	39.86	<0.001*
• Medical Record Number	9	18.0	26	65.0	25	62.5	25.96	0.001*
SITIUATION								
• Symptom / problem	49	98.0	40	100.0	40	100.0	1.61	0.45
• Patient stability	33	66.0	36	90.0	40	100.0	20.58	0.001*
• Level of patient concern	5	10.0	15	37.5	36	90.0	58.73	<0.001*
BACKGROUND								
• History of presentation	31	62.0	37	92.5	32	80.0	11.95	<0.001*
• Date of admission and diagnosis	47	94.0	30	75.0	39	97.5	12.46	0.002*
• Relevant past medical history	16	32.0	26	65.0	29	72.5	17.22	<0.001*
ASSESSMENT								
• What is diagnoses?	50	100.0	40	100.0	40	100.0	0.00	1.00
• Impression of situation	38	76.0	40	100.0	32	80.0	10.78	0.005*
• What have you done so far?	3	6.0	12	30.0	29	72.5	44.27	<0.001*
RECOMMENDATIONS								
• What want to be done?	17	34.0	38	95.0	40	100.0	63.31	<0.001*
• Treatment/investigation needing monitoring	49	98.0	35	87.5	38	95.0	4.38	0.11

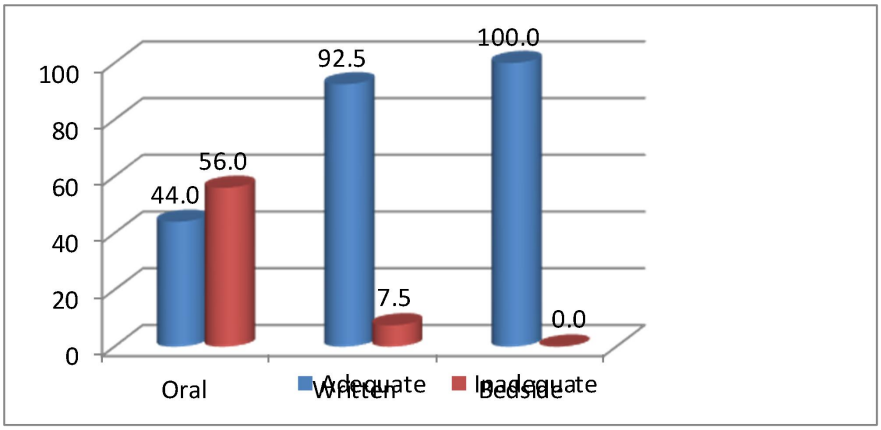

Figure (1): Total ISBAR application as observed among staff nurses in the three study groups.

Table (3): Total assessment of handover process as observed among staff nurses in the three study groups.

Adequate (60%+) Handover process	Handover Oral (n=50)		Written (n=40)		Bedside (n=40)		X^2	p-value
	No.	%	No.	%	No.	%		
Conduct	22	44.0	31	77.5	32	80.0	16.47	<0.001*
Teamwork	29	58.0	34	85.0	39	97.5	21.98	<0.001*
Quality	19	38.0	28	70.0	35	87.5	24.57	<0.001*
Circumstances	48	96.0	28	70.0	18	45.0	29.02	<0.001*

Table (4): Total assessment of perception of handover as reported by staff nurses in the three study groups.

High (60%+) Handover perception	Handover Oral (n=50)		Written (n=40)		Bedside (n=40)		X^2	p-value
	No.	%	No.	%	No.	%		
Efficacy	13	26.0	7	17.5	11	27.5	1.31	0.52
Interaction/support	46	92.0	34	85.0	16	40.0	34.83	0.001*
Knowledge quality	39	78.0	35	87.5	31	77.5	1.69	0.43
Patient participation	4	8.0	27	67.5	12	30.0	35.79	0.001*

Table (5): Relations between staff nurses application of ISBAR and their characteristics.

	ISBAR					
	Adequate		Inadequate		X^2test	p-value
	No.	%	No.	%		
Age:						
<30	78	75.0	26	25.0		
30+	21	80.8	5	19.2	0.38	0.54
Gender:						
Male	12	48.0	13	52.0		
Female	87	82.9	18	17.1	13.51	0.001*
Qualification:						
Diploma	10	66.7	5	33.3		
Bachelor	89	77.4	26	22.6	Fisher	0.35
Age:						
<5	59	77.6	17	22.4		
5+	40	74.1	14	25.9	0.22	0.64
Training courses in:						
Nursing administration:						
No	61	73.5	22	26.5		
Yes	38	80.9	9	19.1	0.89	0.34
Handover:						
No	3	60.0	2	40.0		
Yes	96	76.8	29	23.2	Fisher	0.59
Handover type:						
Oral	22	44.0	28	56.0		
Written	37	92.5	3	7.5	46.88	<0.001*
Bedside	40	100.0	0	0.0		
Handover time:						
Shift start	48	87.3	7	12.7		
Shift end	45	66.2	23	33.8	—	—
Any time	6	85.7	1	14.3		

Table (6): Correlation between ISBAR, handover process, and perception scores and staff nurses' characteristics

	Spearman's rank correlation coefficient		
	ISBAR	Handover process	Perception
Age	.170	.275**	.031
Qualification	.157	.203*	.125
Experience	.077	.144	-.017

Table (7): Total handover process practice as reported by head nurses in the three study groups.

	Handover							
	Oral (n=6)		Written (n=6)		Bedside (n=6)		X^2	P-value
	No.	%	No.	No.	%	No.		
Structure	3	50.0	4	66.7	6	100.0	--	--
Process	0	0.0	6	100.0	6	100.0	--	--
Outcomes	2	33.3	4	66.7	3	50.0	--	--

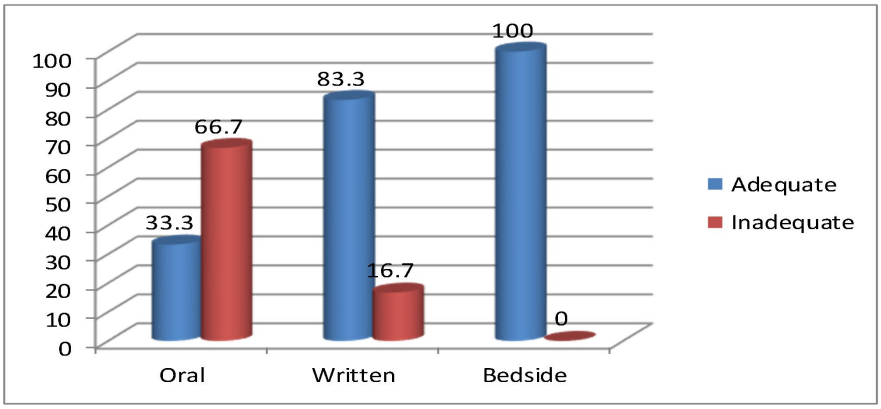

Figure (3): Total handover process practice as reported by head nurses in the three study groups.

Table (8): Comparison of the incidence of medication errors as an indicator of patient outcomes in the three study groups.

Total errors	Handover type						X^2 test	p-value
	Oral		Written		Bedside			
	No.	Incidence@	No.	Incidence@	No.	Incidence@		
By nurses	165	7.96	66	4.93	33	0.82	215.1	<0.001*
Overall	375	18.09	334	24.96	115	2.87	637.3	<0.001*
% by nurses		44.0		19.8		28.7	108.4	<0.001*

Table (9): Comparison of the incidence of falls and bed sores as indicators of patient outcomes in the three study groups.

	Handover type					
	Oral		Written		Bedside	
No. of patients	282		313		242	
No. of patient*days	1377		1150		1029	
Bed sores:						
No. of patients at risk	278		291		213	
	No.	Incidence@	No.	Incidence@	No.	Incidence@
No. with sores	2	0.72	1	0.34	0	0.00
Falls:						
No. of patients at risk	279		291		242	
	No.	Incidence@	No.	Incidence@	No.	Incidence@
No. of fallen patients	0	0.0		0.0	0	0.0

Table (10): Comparison of the incidence of ICU acquired infections as an indicator of patient outcomes in the three study groups.

	Handover type						X^2 test	P-value
	Oral		Written		Bedside			
No. of patients	49		17		12			
No. of patient*days	2073		1338		4004			
	No.	Incidence@	No.	Incidence@	No.	Incidence@		
ICU acquired:								
Blood stream	13	6.27	4	2.99	4	1.00	2.541	0.280
Primary	11	5.31	4	2.99	4	1.00	0.957	0.619
Secondary	3	1.45	0	0.00	0	0.00	--	--
Pneumonia	2	0.96	0	0.00	0	0.00	--	--
UTI	8	3.86	4	2.99	0	0.00	--	--

Discussion:

Nursing handover is a daily activity aimed at transfer of responsibility for a patient from an outgoing (sender) to an incoming (receiver) nurse, with transmission of clear and full related information. It is considered as a cornerstone of quality and safe patient care

(Kim et al., 2020; Lee et al., 2021). However, and unfortunately, often this process is inadequately performed, with the sender missing important details about the patient, or adding irrelevant details, and/or the receiver not paying full attention, thus jeopardizing patient safety ***(Burgess et al., 2020).***

This study aim was to examine the influence of three different nurses' handover styles on selected patient safety indicators. The study findings point to bedside and written handoff style as better styles in comparison to the oral type. This is evident from the comparison of the adequacy of application, efficiency, and staff nurses' perception, and most importantly concerning patient safety outcomes of medication errors and acquired infections. The findings provide a clear answer the research question indicating the supremacy of the bedside handover style followed by the written one.

The study compared different handover styles in three units that had exactly the same characteristics for a fair comparison of the three styles with no confounding effects of units' factors. Thus, according to the head nurses, the units had the same number of beds, close numbers of nurses, with a nurse/patient ratio 0.5. The only difference was in the nurses' levels of qualification. The similarity of these characteristics in the three groups would guarantee that the effectiveness of the handover style in improving patient safety is not affected by such characteristics.

The present study compared the handover styles application in the three units through examining their use of the ISBAR tool. This standardized tool was used since it provides a framework approved by the World Health Organization for effective communication and it can be applied in various situations ***(Burgess et al., 2020).***

The results of the current study demonstrated that the application of handover using the ISBAR tool was lowest in the oral group, with less than a half of its staff nurses having adequate application. In contrast, all staff nurses in the bedside group, and almost all of those in the written group had adequate application. This indicates that the oral style is inferior in comparison with the other two styles. In agreement with this, a study of nursing handover in Norway clarified that in the oral handover style there is a higher risk of information loss ***(Nygaard et al., 2020).***

Overall, the staff nurses' adequacy of application of the handover process was lowest in the oral style group, and highest in the bedside group. The finding indicate that the bedside handover style is the most applicable, followed by the written style. The low adequacy of the oral type might be explained by that it is more liable to missing or losing important information as highlighted by ***Nygaard et al., (2020).***

Staff nurses' perception of the handover efficacy was assessed in the current study given its importance in their compliance with the process. The findings indicate that the staff nurses' perception area of efficacy was the lowest among the four areas. This was mostly due to that they perceive the handover takes too much time, and that they can get handover information from patient file. Thus, they may perceive the process of handover is of low efficacy.

Overall, the present study results indicate the staff nurses' perception of the handover process was highest in the written style group. This might be attributed to that in the written style they may have more time to prepare their paperwork. Also, they may feel more comfortable in the process in comparison with the oral or bedside styles were personal interactions in the presence of others may be required. In line with this, a study in Denmark demonstrated improved information exchange and diagnostic accuracy when written handoff

was used ***(Balslev et al., 2021).*** Similar findings were also reported from a study in the Netherlands where written handover was associated with better understanding of patient problems ***(van Heesch et al., 2020).***

A main objective of the present study was to compare the rates of certain patient safety indicators in the three settings adopting three different handover styles. The first indicator was that of medication errors. The findings demonstrated that the errors related to wrong medication dose and/or concentration, duplication, omission/ discontinuing, and preparation were the most commonly encountered. These were similarly reported in previous literature ***(Eisenbach et al., 2020; Ibrahim et al., 2020; Skeie et al., 2021).***

Meanwhile, although the incidence of the total medication errors was significantly lowest in the bedside handover style, the percentage of errors committed by nurses to overall errors was significantly lower in the written group. This may indicate that the bedside style may have a positive impact on all medication errors whether committed by nurses or by other healthcare team members, which gives even more credit to this style. In congruence with this, a recent systematic review provided evidence of a significant reduction in medication errors when standardized handover approaches were applied ***(Hada and Coyer, 2021).***

The second patient safety indicator investigated in the present study was that of acquired infections. The results indicate that it was also lowest in the bedside group and highest in the oral group. This was noticed regarding the recurrence of episodes of infection, as well as the ICU acquired infections. The findings again point to the superiority of the bedside handover style in comparison with the other two styles in protecting patients and enhancing their safety. Similar reductions in infections were reported with the use of a standardized handover approach with the application of the ISBAR tool in a study in China ***(Ji et al., 2021).***

According to the current study results, the incidence of bed sores was zero in the bedside group, and very low in the oral group. Moreover, the incidence of patient falls was zero in all study groups. The findings point to high levels of patient safety regarding these two indicators in the study settings. In this perspective, a study in Italy demonstrated no relation between patient falls and safety events and nursing handover ***(Demaria et al. 2021).***

Additionally, the present study multivariate analysis identified staff nurse's age as a significant positive predictor of the score of handover process application. Thus, the older age nurses have better application in comparison with the younger ones. This might be explained by the accumulated experience as well as the self-confidence they gain in handover encounters. In line with this, studies in South Korea ***(Kim et al., 2020)*** and Hong Kong ***(Pun, 2021)*** showed that nurses' perception of the application of handover was significantly influenced by their personal and job characteristics.

Conclusion:

The results of the study conduce to the conclusion that the adequate application of ISBAR as well as of the handover process is lowest in the oral handover style, and highest in the bedside style. The bedside and written styles predict better application of handover. This indicates that the bedside and written handover style are better than the oral style in terms of patient safety.

Recommendations:

- The bedside nursing handover style should be the style of choice to be applied whenever possible.
- Nurses should have regular training in the process of handover

- Important areas for future research include developing a minimum dataset requirement for handover and the design and development of technological solutions to improve the quality, standardization, and efficiency of handover data.
- The evaluation of methods of clinical handover needs to be linked to measures of patient safety, particularly relating to miscommunication such as falls, medication errors or pressure ulcers.

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