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Effects of an Electronic Checklist on the Quality of Patient Care Handoff Process from the Operating Room to Intensive Care Unit

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Abstract

Background and Aim: Handoff is one of the main processes of health care providers. Paper checklist is commonly used to handoff care from operating room (OR) to intensive care unit (ICU). However, this tool do not guarantee accurate and complete exchange of information during handoff. The present study aimed to investigate the effects of an electronic handoff checklist on improving the quality of care transfer from the OR to ICU.

Materials and methods: The sample of this quasi-experimental study included all situations of patient handoffs from the OR to ICU at Golestan Hospital in Ahvaz city. Accordingly, 84 handoff situations were randomly divided into 2 equal control and intervention groups and participants completed paper or electronic checklists respectively. Quality of care handoff was assessed with Handover Evaluation Scale (HES).

Results: Mean HES scores in paper-checklist and electronic-checklist groups were 35.38±3.66 and 38.10±3.61 respectively. Handoff scores in two dimensions of quality of information and efficiency in the electronic-checklist group were significantly higher than another group (P= 0.004).

Conclusion: It seems electronic handoff checklist can increase the quality of patient care handoff from OR to ICU.

Keywords: Patient Handoff, Checklist, Operating Room, Intensive Care Unit.

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Introduction

Patient handoff or care transfer, the simultaneous and reciprocal process of transferring a patient with his specific information from one team/person in charge of care to another team/person to ensure safety and continuation of care process, is one of the riskiest procedures in treatment if not done properly. It may involve potentially dangerous consequences for patients and health care team [1]. The information transmitted between health care experts must be adequate, accurate and integrated [2]. It is well established that care transfer is a vulnerability where valuable patient information can be distorted or omitted [3]. Therefore, providing a theoretical model that distributes knowledge through artifacts (paper or electronic tools) among clinical staff and supports its use in activity systems such as operating rooms (ORs) and intensive care units (ICUs) can prevent information loss and increase coordination in clinical settings [4].

In order to prevent information loss during patient transfer, a standard protocol can help improve the quality of care transfer postoperatively. This type of protocol has been demanded as a checklist for years by various medical associations and WHO [4, 5]. Previous studies have used standard checklists to help structure the oral communication process between the OR transfer team and the ICU receiving team. Findings of Salzwedel et al. (2016) with the aim to determine the effect of using checklists on the transfer quality of patients from the ORs to the ICUs showed that the use of standard checklists increased the amount and quality of medical information by 13 percent [6]

A checklist, however, only provides the structure needed for simple communication but does not guarantee a complete and accurate exchange of information in itself

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during handoffs. Meanwhile, providers are often forced to recall information related to critical elements of clinical care from their memory [7]. This process can be problematic because of inadequate and inaccurate data collection. This problem becomes especially serious during postoperative transition because the surgical ward itself generates a large amount of critical information, and different providers often concern about patient care during surgery. Thus, it is a critical need to have a communication tool as a delivery checklist to facilitate the transfer [8].

Despite the well-known problem of care transfer, a few studies have been conducted to design and evaluate digital (electronic) tools to facilitate the process of handoff, which are limited to certain fields. In fact, patient care delivery has been monitored during the shift change of medical staff. Moreover, due to limited sample size, the results of these studies do not have enough credibility [9, 10]. This study aimed to develop an electronic (digital) tool and determine its effectiveness in care transfer of intubated patients undergoing general surgery from the OR to ICU.

Methods

In this quasi-experimental study, samples included all situations of patient transfers from the OR to ICUs of Golestan Hospital in Ahvaz city, Iran, selected via convenience sampling method and inclusion criteria. The criteria for the staff involved were willingness to participate in the study, work experience at ICU for at least 2 years, having at least a bachelor degree in nursing (recipient) and anesthesiology (handover), and immediate transfer of intubated patient undergoing general surgery to ICU. Exclusion criterium was unwillingness to participate in the study at any time.

The following formula was used for calculation of sample size and according to Bruno and Guimond study (2017) [11] (α=0.05, power=90%), scores of handoffs in first group (mean=9.5, SD=3.36), the

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second group (mean=20.9, SD=1.74) and average difference of the two groups=1.9. The sample size for each group was calculated as 42 transfers (84 transfers in total).

$$n = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta} \right)^2 (s_1^2 + s_2^2)}{(d)^2}$$

Handoffs were selected according to the inclusion criteria from predicted patient transfers from the OR to ICU. The transfers were then divided randomly into 2 intervention and control groups with a table of random numbers.

Based on existing anesthesia forms at different medical centers as well as literature review, common items were extracted, and a new checklist was designed. In its final version, it was given to programmers to make an Android application for installation in a tablet. Before surgery, one of the researchers trained anesthesiologists to work with the application and resolved any possible problem.

The anesthesiologist in the intervention group entered the data into the application instead of filling a routine paper report during the operation. After the operation, an electronic report was printed from the application and immediately given to the ICU nurse who was responsible for receiving the patient. In fact, the nurse was fully aware of the patient's condition before the patient was transferred to the ICU. Finally, the patient was transferred to the ICU based on the report obtained from the application in the presence of the anesthesiologist.

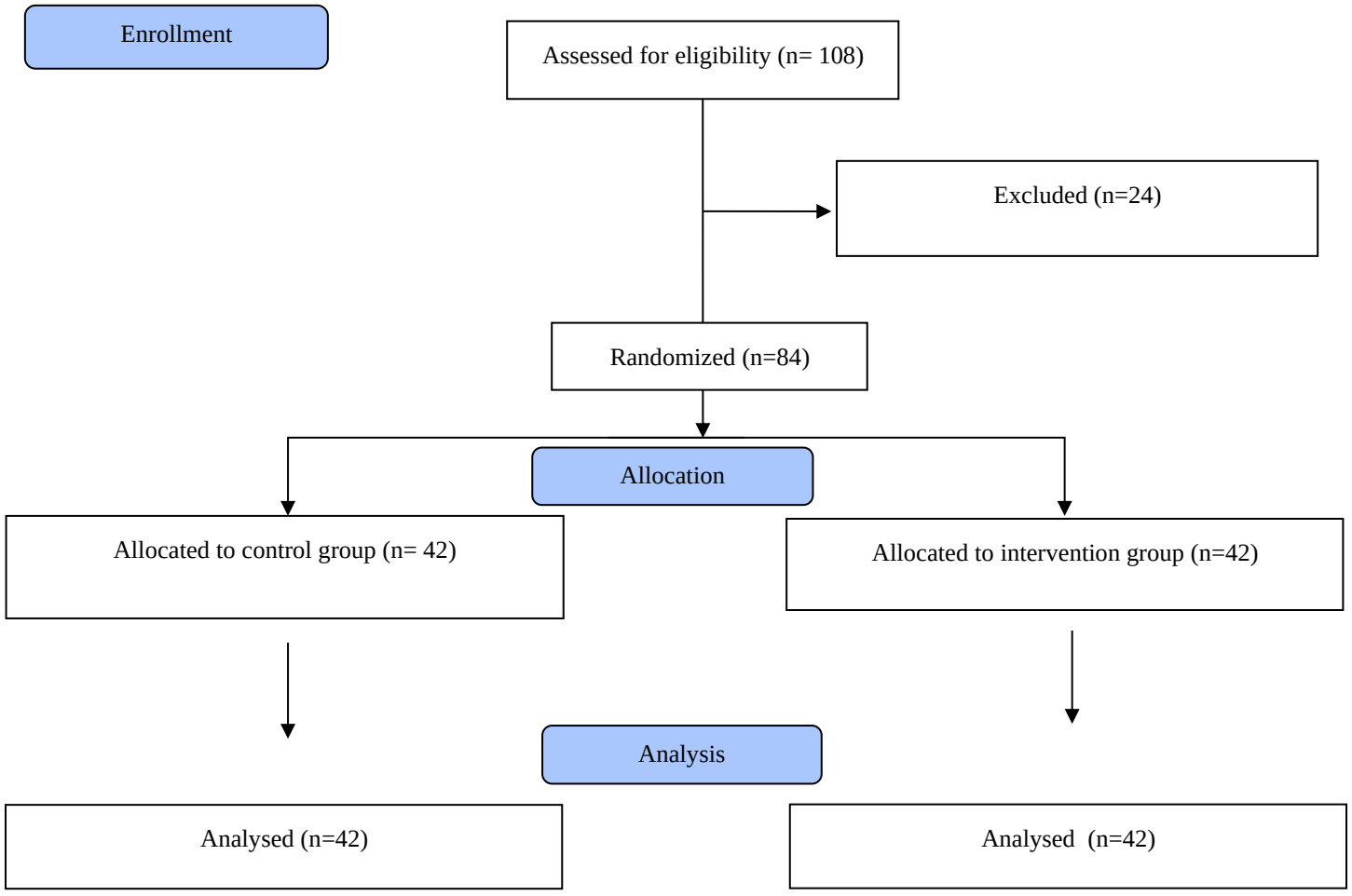
In the control group, handoff was performed routinely without the application. In this way, the patient was transferred to the ICU with paper forms of his/her record and Kardex. They include the doctor's order to admit the patient to the surgical ICU and the new orders listed in the doctor's order sheet. The Kardex of the patient's hospitalization includes medications, tests on demand, connections, Braden score, level of care, as well as the

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recovery report written by the anesthesiologist. In both groups, Handover Evaluation Scale was completed by the receiving nurse and the data were recorded. At last, the quality of patient transfer in the groups was compared (fig 1).

Fig. 1. Study Flow Diagram



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Data collection tool consisted of three parts. The first part was a demographic questionnaire; the second included the Handover Evaluation Scale designed by O'Connell et al. (2014) to assess the quality of care transitions [12] and the third was the electronic transmission checklist.

Handover Evaluation Scale (HES): It is a 4-point Likert scale from completely disagree", "disagree", "agree" to "completely agree" with 14 items and 3 subscales: quality of information transfer (6 questions), quality of interaction and support (5 questions), and productivity (3 questions). Its scores range from 14 to 56: 14-28 poor quality, 29-42 moderate quality, and above 43 good quality of handoff. Since it was used for the first time in our study, it was translated and edited by an English language expert and a team consisting of 3 nursing faculty members and two anesthesiologists. The content validity was checked and confirmed by 10 faculty members of Ahvaz Jundishapur School of Nursing and Midwifery. Its reliability was checked with a pilot study and 10 ICU nurses. Cronbach's alpha coefficients for its subscales were calculated 0.8, 0.86 and 0.64 respectively and for the whole scale (r=0.78), which verified its internal consistency.

Electronic checklist: At first, based on existing anesthesia forms in different medical centers as well as textbooks and authentic articles in the field of patient delivery and transfer of care, appropriate items were extracted, and the initial form was designed. Then, in order to confirm content validity, the form was given to 10 faculty members of nursing, anesthesiologists and experienced ICU nurses, and their corrective comments were applied. All participants signed the written informed consent. Also, all experimental protocols were approved by the research vice-chancellor of Ahvaz Jundishapur University of Medical Sciences (Ethical code: IR.AJUMS.REC.1398.280).

Such quantitative variables as mean, median, standard deviation etc. and

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qualitative variables like number and percentage were reported. Independent t-test was used to compare the means of variables in the two groups, and if the test was not applicable, its non-parametric equivalent, Mann-Whitney test was used. Normality of quantitative variables were assessed by Shapiro-Wilk test.

Results

Demographic characteristics of nurses including gender, age, work experience, and educational level are shown in Table 1. Fifty-two (61.9%) of them was women and 32 (38.1%) was men with no significant difference (P=0.50) based on Fisher's exact test. In terms of age, most of them were in the range of 30-35 years. Based on Mann-Whitney test, no significant difference was found between the 2 groups (P=0.74).

In total, 67 nurses (79.8%) had bachelor degree and 17 nurses (20.2%) had master degree. Fisher's exact test showed no significant difference between the 2 groups in terms of educational level (P=0.59). Seventy-five percent (63 people) had more than 5 years of work experience with no significant difference between the groups (P=0.31) (table 1).

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Table 1. Demographic characteristics of nurses participating in the study by intervention and control groups

Variables		Control	Intervention	P value
		n(%)	n(%)	
Gender	women	28(67)	24(57)	*0.50
	men	14(33)	18(43)	
Age (year)	< 30	8(19)	5(12)	**0.74
	30-35	21(50)	28(67)	
	36-40	7(17)	6(14)	
	> 40	6(14)	3(7)	
Work experience (year)	> 5	29(69)	34(81)	*0.31
	<5	13(31)	8(19)	
	BSc.	32(76)	35(83)	
	MSc.	10(24)	7(17)	

*Fisher's exact test

**Mann-Whitney statistical test

However, a significant difference was found between the Quality of handoffs in the groups (p=0.004) (table 2).

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Table 2. Comparison of handoffs Quality overall in the control and intervention groups

Handoff Quality	Control group	Intervention group	P value
	n(%)	n(%)	
Poor quality	5(12)	1(2.38)	*0.004
Moderate quality	36(86)	35(83.2)	
Good quality	1(2)	6(14.3)	
Mean ± SD	3.66±35.38	3.61±38.10	

*Independent t-test

Findings showed an increase in the quality of information transfer (16.80±2.67 vs.18.1±3.06) and productivity (8.09±1.60 vs 8.71±1.36) in the intervention group compared to the control group with a significant difference (p=0.032, p=0.007), but in the quality of interaction and support subscale, no significant difference was found (p=0.132) (table 3).

Table 3. Comparison of Handsoff Evaluation Subscales in the Control and Intervention Groups

HES subscales	Control group	Intervention group	P value
	Mean ± SD	Mean ± SD	
Quality of information transmission	16.80±2.67	18.10±3.06	*0.032
Quality of interaction and support	10.45±3.25	11.26±2.00	*0.132
Quality of efficiency	8.09±1.60	8.71±1.36	*0.007

*Independent t-test

Discussion

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Several institutions in different countries have developed electronic tools for patient handoff process. Evidence shows that the integration of such tools in electronic health record helps to improve information transfer, enhance communication between health care providers, and reduce medical errors [13, 14]. Similarly, our results showed improvement in the process of patient handoff from the OR to ICU. The mean score of the process with paper checklist was 35.38, which increased to 38.10 with electronic checklist. This is consistent with the findings of Shah et al. (2019) who used an electronic checklist to facilitate the transfer of intubated patients from the OR to ICU [8]. Similar studies by Duclos et al. (2016) [15], Agarwala et al. (2015) [13] and Thongprayoon et al. (2016) [16] showed better results in the quality of handoff with electronic checklists.

Our study showed an increase in two subscales (quality of information transfer, and productivity). Agarwala et al. (2015) examined the usability and applicability of an electronic checklist for handoff during surgery at shift changes in anesthesia staff. Their results showed a significant increase in the frequency of information transfer, particularly on prescribing drugs [13]. Raval et al. (2015) also examined the effects of electronic checklist on handoff efficiency and accuracy of information exchange. Their findings showed that electronic checklists can improve handoff efficiency and information transfer in an outpatient surgical setting [17]. It can be said that improved quality of information transfer may be due to better organization of this aspect with electronic checklists. This, in turn, may reduce medical errors during patient care. According to the literature and based on the results of our study, it seems that the design and use of electronic checklists during handoffs in different wards and levels can reduce medical errors, boost immunity and improve patient care [14].

In its simplest form, handoff can be considered an interaction in which

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information is sent, received and processed between 2 health care providers [13, 18]. Our results showed that, after the intervention, the level of interaction and support among nurses increased. Therefore, it seems that the use of electronic checklists has improved interaction and support in the process of patient handoff and has created an atmosphere for mutual understanding with a positive approach to the process of care transfer.

The results of various studies have shown that patient transfer process is time-consuming for many different members of medical staff, especially nurses, and they receive irrelevant information during the care transfer process. Therefore, it is important to investigate about the efficiency of information sharing during care transfer. Consistent with Robin's study [19], the results of the current research indicate the increase in the effectiveness of the electronic checklist compared to the paper checklists. Our findings showed that integration of electronic checklists can affect many aspects of care transfer between hospital wards, especially patient handoff from the OR to ICU.

Conclusion

Although our results showed the positive effects of electronic checklist for handoff from the OR to ICU, this cannot be concluded for other wards and needs further investigations. Our study may pave the way for further studies in this field and help to expand nursing knowledge. The results can be a basis for other studies regarding the effectiveness of quality of information and efficiency with electronic tools among different medical centers. One of our limitations was the small size of research population. Therefore, it is recommended to conduct studies on larger populations. Considering to the study method, the comparison of the two groups was after the intervention, another limitation was the impossibility of comparing the data before the intervention in the two groups. In addition, our results cannot be generalized to other wards or departments.

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Conflict of Interest

The authors declare no conflict of interest in conducting and publishing the research.

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