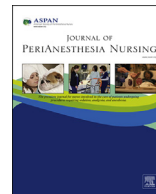




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Research

Cohort Study on the Implementation of a Surgical Checklist from the Operating Room to the Postanesthesia Care Unit

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A B S T R A C T

Keywords:

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Purpose: To provide evidence of a well-structured information transfer that prevents the loss of information relevant to patient care.

Design: Pre-post cohort study on the implementation of a surgical checklist from the operating room to postanesthesia care unit.

Methods: Main variable was the transfer of relevant and correct information. The secondary variables include time, interruptions, and satisfaction.

Findings: In the prechecklist stage, 59 transfers were collected; with an average time of 68.5 seconds, 41.7% of the transfers encountered interruptions, and only 8.5% of the reports were complete with all data. After instituting the checklist, 63 transfers were analyzed with an average time of 96.4 seconds, no interruptions occurred in 71.3% of the transfers, and all the items were transmitted in 92.1% of the cases. Number of interferences decreased. Transfer time increased significantly, but 80.3% of staff found the checklist useful.

Conclusions: A written and structured checklist minimizes the loss of relevant information, thus improving safety in the process.

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Patient handover is defined as the information and responsibility transfer between health care teams in different care areas.¹ The patient information transfer from the operating room (OR) to the postanesthesia care unit (PACU) is carried out by the anesthesia provider and nurse in each OR. They are responsible for taking the patient from the OR to PACU and providing the registered nurse of the team in charge of that patient with relevant patient and surgical information. This information is usually given verbally.

Safe patient handover requires information to be given in a clear structured way and without interruptions.^{2,3} Information

transmitted during patient handover is often insufficient, unstructured, and with frequent interruptions, which have a negative effect on the information retained by the receiver.⁴⁻⁶ Passing on information verbally also results in missed information between shift or unit changes. About 70% of the incidents that may jeopardize a patient's safety are caused by communication errors. Kluger and Bullock⁷ demonstrated that 14% of the anesthetic incidents taking place in PACU could be related to communication failure.

Among the strategies described in the literature for a safe patient handover are the following²:

- Prepare monitor, alarms, and equipment before patient's arrival.
- Monitor vital signs before starting information transfer.
- Avoid carrying out other tasks while information is being provided. Avoid interruptions.
- All the team members in charge of the patient must be present.
- Make sure the members in charge speak one at a time.
- Devote the necessary time to the information transfer.
- Use a structured checklist to guide the information transfer.

This work was performed at Center Quirúrgic Ambulatori, Parc Taulí Hospital Universitari, Institut d'Investigació i Innovació Parc Taulí I3PT, Universitat Autònoma de Barcelona, Barcelona, Spain.

Conflict of interest: None to report.

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- Teach and educate all the staff to perform a safe patient handover.

According to the literature, a checklist to guide patient handover must include the data listed in Table 1.² Elaboration of a checklist is an important strategy. The aim of the study is to provide an evidence of a well-written and well-structured information transfer that prevents the loss of information relevant to patient care.

Likewise, the secondary aims were as follows:

- To describe the way information is transferred.
- To develop and implement an information transfer checklist for clinical practice.
- To determine the professionals' degree of satisfaction with the new tool.

We hypothesize that analyzing how oral information is transmitted, designing a checklist, and carrying out the procedure with the checklist will improve communication between the OR and PACU, continuity of care, and patient safety.

Methods

A prospective observational study was designed, pre-post procedure, on the implementation of a surgical checklist from the OR to PACU. The study analyzed the information transfers performed at the PACU of a central surgical block of a referral university hospital, which serves a population of 480,000 inhabitants.

The study was divided into three stages:

Stage 1: Verbal Information Transfer

Before this stage, a datasheet was designed with the patient's relevant information, which, according to the literature, should be communicated during patient handover.¹

In June 2016, a cross-sectional study was conducted; the information that was transmitted verbally by the anesthesiologist and OR nurse to the PACU staff was observed and recorded for 3 days. All patient handovers performed in the PACU of the surgical area before using a check sheet during the cross-sectional days were collected. Handovers were timed, and the number of interruptions was recorded. The percentage of relevant information that was not transmitted was analyzed. The observations were conducted by two anesthesiology residents.

After 20 minutes, the PACU nurse was queried about the patient's relevant information, and the source the nurse used to provide such information was recorded (memory, preoperative

anesthesia form, operative report, and computerized medical history), and the amount of time used to give such information was also measured.

Stage 2: Educational Intervention

On October 2016, education sessions were carried out both at the anesthesiology service and for OR and PACU nurses. These sessions explain how to provide an information transfer in a safe way. In addition, the checklist tool was introduced. At this stage, the written information transfer was implemented for 12 months so as to achieve a successful consolidation of the use of this tool.

Stage 3: Information Transfer Using the Checklist

After the checklist implementation time, two cross-sectional days took place, when information transfer time was recorded, and the number of interruptions was observed. The percentage of incorrect information transmitted was controlled by contrasting the information provided by the responsible OR nurse with the patient's medical history. At the end of the study, a satisfaction survey was conducted among all the professionals involved.

The subject of the study defined was as follows:

- The information transfer taking place at the end of a surgical procedure.
- Between the OR professionals and the PACU professionals.
- During the two cross-sectional days in each stage.

Simultaneous handovers, when two patients were admitted at the same time, were excluded.

For the sample size calculation, it was taken into account that 2,512 surgical procedures had been performed in 2015, needing 61 information transfers in each stage so as to reach a confidence interval of 90%, and a margin of error of 10%.

The main variable was defined as the transfer of relevant and correct information, provided by the anesthesiologist and OR nurse to the responsible PACU staff both verbally and in writing; expressed as the percentage of transmitted items out of the total that should be transmitted.

Secondary Variables

Secondary variables included were:

- Time used for the information transfer, measured in seconds.
- Number of interruptions (understood as those actions that halted the continuity of the information process, whether relevant or not).
- Source of information that the nurse used to transmit the patient's relevant information (memory, medical history, and/or preoperative forms).
- Number of successful handovers according to the guidelines defined during the training stage.
- Number of handover errors: information provided in the checklist, which, once the patient's medical history was reviewed, was found to be incorrect.
- Degree of satisfaction among professionals.

A possible bias could be that the same anesthesiologist might perform more than one transfer during the cross-sectional days. For this reason, the collection of data was carried out on different days to obtain a more heterogeneous and sufficient sample.

The Statistical Package for the Social Sciences (SPSS, version 22, IBM, Armonk, NY) was used to analyze the final data. A comparison

Table 1
Checklist Items

Patient identification data and basic information	• Name • Age • Weight • Known allergies
Anesthesia information	• Relevant medical history • Type of anesthesia • Anesthetic complications • Intraoperative medication given: dose and administration time
Procedure information	• Type of procedure • Drains, catheters, etc • Surgical complications
Postoperative plan	• Postoperative treatment • Antithrombotic prophylaxis • Postoperative pain control guidelines • Additional tests to be performed

between the data in Stage 1 and Stage 3 was carried out to determine the required time and the number of interruptions that occurred. Statistically relevant differences were also identified using nonparametric testing (Mann-Whitney *U* test and Wilcoxon *W* test).

The study was approved by the institution's Scientific Research Ethics Committee, with the code number 2017529. Informed consent was not necessary, as information transfer is a common medical practice. No conflict of interest occurred. The data collected were anonymous, and compliance with the applicable legislation on confidentiality was done. All professionals involved were informed of the study.

Results

Stage 1: Verbal Information Transfer

A total of 59 handovers were collected on three randomized days; six handovers were excluded because of simultaneous PACU admittance.

In 91.5% of the handovers, some items from the checklist were ignored. Regarding the patient's relevant medical history, the following were not communicated: allergies (37.3%), ischemic cardiopathology (6.8%), arrhythmias (1.7%), diabetes mellitus (5.1%), and severe chronic obstructive pulmonary disease (1.7%). In relation to the intraoperative procedure, the following were not communicated: surgical positioning (91.5%), intraoperative measures intended to prevent hypothermia (91.5%), venous or arterial lines (62.7%), antiemetic medication provided (54.2%), drains and their location (45.8%), dressings, splints, casts and bandages (50.8%), relevant intraoperative complications regarding anesthesia (42.4%) and surgery (50.8%), the type of anesthesia (13.6%), the type of procedure (10.2%), analgesia given (10.2%), and osmotics (5.1%). With respect to the continuity of postoperative care, the following were not communicated: discharge destination (79.7%), postoperative analgesia (23.7%), and complementary tests (15.3%). Interruptions during information transfer occurred on 41.7% of the cases. On one particular handover, four interruptions took place, none of which were of vital importance. The transfer time per patient was 68.5 seconds (29 to 143), and interruptions occurred on 46.7% of such handovers (0 to 4).

When the PACU nurse was asked about the patient's relevant information (20 minutes later), the source the nurse used to provide such information was as follows: memory (51.6%), computerized medical history (25%), preoperative anesthesia form (6.6%), and combination of several sources (16.8%). The average time used to give the information again was 61.3 seconds (30 to 149).

Stage 2: Educational Intervention

The research team carried out two educational sessions for all the anesthesiology and nursing professionals, introducing the information transfer checklist and different steps in its use. Agreement was obtained on how to perform the information transfer from the OR to PACU. According to the bibliography reviewed,^{8,9} the selected items were:

1. Monitoring vital signs of the patient should occur first.
2. The PACU nurse will be the one who will be asking the checklist questions, always following the same order.
3. Avoid interruptions during the process, unless vital emergency situations occur.

4. Prevent more than one person from simultaneously transmitting the information.

The checklist was subsequently implemented. Although it had been originally decided that the time between implementation and assessment would be a month, it took 1 year, because of reasons beyond the control of research team (eg, renovation works, staff changes, holiday periods).

Stage 3: Information Transfer Using the Checklist

Sixty-three patient handovers were collected in 3 days. When the information was controlled by contrasting it with the patient's medical history, in 92.1% of the cases, all the checklist items were transmitted correctly. In 7.9% of the handovers, some relevant information had not been transmitted, and some other transfers contained several mistakes. The omitted information was in two cases, the necessary additional tests for the postoperative period were not transmitted; in two cases, medical history was not transmitted (hypertension and chronic obstructive pulmonary disease); in two cases, allergies were not communicated; in one case, the antiemetic medication provided in the OR was not transmitted; and, finally, in one case, the postoperative antithrombotic prophylaxis was not transmitted. The average transfer time was 96.4 seconds (26 to 204). In 71.4% of the handovers, no interruptions occurred; in 25.4%, there was one interruption; and in 3.2%, three interruptions occurred. No significant differences are observed between both stages ($P = .143$).

If handovers with interruptions are excluded, the average time is 87.9 seconds (30 to 210); 8.5 more seconds than in the first stage. Therefore, transfer time increases, which is statistically significant ($P = .002$).

Handovers were not performed correctly 14.3% of the time. The following incidents occurred: in 6.3% of cases, the checklist procedure started before monitoring the patient (four occasions). In 1.6% of the handovers, the anesthesiologist was not present; in 1.6% of handovers, the OR nurse was not present, and in 1.6%, the anesthesiologist and OR nurse were speaking simultaneously.

For the assessment of the degree of user satisfaction, the data have been analyzed by groups. In the anesthesiology group, 83.3% were attending anesthesiologists, and 16.7% were residents, with ages: 10% between 24 and 30, 46.7% between 31 and 40, 20% between 41 and 50, and 23.3% between 51 and 65. Their answers to the satisfaction survey are shown in Table 2.

In the nursing professional group, 77.8% of them were OR nurses and 22.2% were PACU nurses, with ages: 36.1% between 22 and 30, 27.8% between 31 and 40, 22.2% between 41 and 50, and 13.9% between 51 and 65. Their answers to the satisfaction survey are shown in Table 3.

No statistically significant differences have been observed regarding age or professional group.

Discussion

The implementation of a surgical checklist between the OR and PACU transfer improved communication and prevented loss of relevant information in 92.1% of patient handovers. We believe that one of the keys to such an improvement is that the PACU staff responsible for the patient admission leads the information transfer by asking the checklist questions to the OR professionals. This result is in contrast to the study by Salzwedel et al,¹⁰ where they achieved an improvement from 32.4% to 48.7% with the use of only a written checklist.

Table 2
Anesthesiologist Satisfaction

The Information Transfer Checklist	Strongly Disagree (%)	Disagree (%)	Neither Agree or Disagree (%)	Agree (%)	Strongly Agree (%)
	1	2	3	4	5
Is useful in my daily practice	6.7	6.7	6.7	46.7	33.3
Is easy to fill in	6.7	3.7	6.7	40	43.3
Allows identification of the patient's relevant information in a fast way	10	3.3	6.7	36.7	43.3
Prevents the loss of information during patient handover and between shift/on-call changes	10	3.3	20	30	36.7
Should be implemented as standard practice in our service	3.3	3.3	0	43.3	50

In 2012, Siddiqui et al.³ published a study on the elaboration of a checklist, where the data that were not communicated were similar to the results of this study regarding both items and proportions.³ In addition, this checklist allows for an established postoperative action program, as it includes pharmacologic treatment, patient destination, and diagnostic tests.

During the first stage, it was noted that the information transfer was being performed in a chaotic way. The information was transmitted verbally while the patient was being monitored, and other tasks were taking place. The anesthesiologist and OR nurse often talked simultaneously. Interruptions of different kinds also occurred, such as telephone calls or helping other professionals or patients who needed assistance from the PACU nurse. All these contributed to the loss of information detected at that stage.

The development of the information transfer checklist emerged from the literature recommendations, observation of daily clinical practice, and the data obtained during the first stage. In the study by Julia et al.,¹¹ an intraoperative checklist was elaborated after discussion within groups of experts. On the other hand, the study by Siddiqui et al.³ was based on the Delphi methodology. Regardless of the different methodologies used in the elaboration of these three checklists, the items included in all of them are similar.

Information transfer time increased by 19.4 more seconds, but the patient safety provided by the checklist becomes more valuable than time increase, although it was a significant increase.¹²⁻¹⁴ Similar results have been observed in the study by Salzwedel et al.,¹⁰ where the time average increased from 86 to 121 seconds; our average was even less. Time increase might have an economic impact. Costs were not analyzed in this study, but it might be taken into account for future research.

The number of interruptions was reduced in relation to the first stage. However, it is still an aspect to be improved, as none of them were necessary. Our figures are similar to those provided by Segall et al.² in their bibliographic review. Interruptions during information transfer may be one of the causes of omission of relevant information, and the literature recommends to avoid interruptions.

Implementing this checklist into clinical practice was not an easy task. There was much resistance to change, mainly because of the new guidelines for transmitting the information. Despite the initial reluctance, most of the professionals agreed or strongly

agreed on the implementation of the checklist as standard clinical practice. They also considered that it is easy to fill in, and it allows a quick identification of relevant information, as opposed to other published checklists, which included a great number of items.¹⁰ The implementation of a checklist can improve professionals' satisfaction.¹⁰⁻¹⁸

In the project's initial design, a shorter checklist implementation time had been suggested (Stage 2), but there were some structural changes in the unit, and new professionals joined in, which forced us to extend that implementation period to 12 months. We believe that extended implementation might have helped both improve satisfaction and obtain better results in Stage 3. The staff was better educated, in contrast to previous studies where Stage 2 was shorter.¹⁰

One of the limitations of this study may have been active observation during handover. Observations took place during the morning shift, from Monday to Friday; the data may have been different if collected in the afternoon, during the night shift, or at the weekend. Another limitation was that it was not controlled whether all the staff was formally trained.

In the future, we plan to have a contingency plan that takes into account if certain instances occur (eg, interruptions, simultaneously transmitting the information, and communication failure).

Recommendations for Clinical Practice

Recommendations for clinical practice include:

1. The use of checklist should be generalized in any process of information transfer.
2. The implementation of the checklist must be accompanied by an educational process.
3. All changes generate resistance; therefore, an implementation strategy will be necessary.

Conclusion

In summary, in the prechecklist stage, only 8.5% of the reports were complete with all data. After instituting the checklist, all the items were transmitted in 92.1% of the cases. Number of

Table 3
Satisfaction of Central Surgical Block Nurses

The Information Transfer Checklist	Strongly Disagree	Disagree (%)	Neither Agree or Disagree (%)	Agree (%)	Strongly Agree (%)
	1	2	3	4	5
Is useful in my daily practice	0	2.8	16.7	38.9	41.7
Is easy to fill in	0	5.6	13.9	33.3	47.2
Allows identification of the patient's relevant information in a fast way	0	2.8	0	50	47.2
Prevents the loss of information during patient handover and between shift/on-call changes	0	2.8	11.1	58.3	27.8
Should be implemented as standard practice in our service	0	0	19.4	30.6	50

interferences decreased. Transfer time increased significantly, but 80.3% of the staff found the checklist useful. A written and structured checklist minimizes the loss of relevant information, thus improving safety in the process.

The quality of oral transfer is influenced by the experience of the professionals involved and their personal features. The checklist minimizes the personal variability of each professional, thus generating a standardized way to transmit information. Therefore, the checklist reduces information omission while increasing patient safety.

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