Implementation of a structured information transfer checklist improves postoperative data transfer after congenital cardiac surgery

Arif Karakaya, Annelies T. Moerman, Harlinde Peperstraete, Katrien François, Patrick F. Wouters and Stefan G. de Hert

BACKGROUND During one hospital stay, a patient can be cared for by five different units. With patient transfer from one unit to another, it is of prime importance to convey a complete picture of the patient’s situation to minimise the risk of medical errors and to provide optimal patient care.

OBJECTIVE(S) This study was designed to test the hypothesis that the implementation of a standardised checklist used during verbal patient handover could improve postoperative data transfer after congenital cardiac surgery.

DESIGN Prospective, pre/postinterventional clinical study.

SETTING Cardiac centre of a university hospital.

PATIENTS Forty-eight patients younger than 16 years undergoing heart surgery.

INTERVENTIONS A standardised checklist was developed containing all data that, according to the investigators, should be communicated during the handover of a paediatric cardiac surgery patient from the operating room to the ICU.

MAIN OUTCOME MEASURES Data transfer during the postoperative handover before and after implementation of the checklist was evaluated. Duration of handover, number of interruptions, number of irrelevant data and number of confusing pieces of information were noted. Assessment of the handover process by ICU medical and nursing staff was quantified.

RESULTS After implementation of the information transfer checklist, the overall data transfer increased from 48 to 73% (P < 0.001). The duration of data transfer decreased from a median (range) of 6 (2 to 16) to 4 min (2 to 19) (P = 0.04). The overall handover assessment by the intensive care nursing staff improved significantly after implementation of the checklist.

CONCLUSION Implementation of an information transfer checklist in postoperative paediatric cardiac surgery patients resulted in a more complete transfer of information, with a decrease in the handover duration.

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Introduction

During one hospital stay, a patient can be cared for by five different units: the operating room; postanaesthesia care unit (PACU); ICU; stepdown unit; and medical/surgical unit. With patient transfer from one unit to another, it is of prime importance to convey a complete picture of the patient’s clinical condition to minimise the risk of medical errors and to provide optimal patient care.¹

A clinical handover refers to the transfer of information and professional responsibility and accountability between individuals and teams, within the overall care system.² Handovers are a ‘high-risk’ process that might influence patient safety by causing gaps in the continuity of care.³,⁴ Increasing attention has focused on the process of data transfer since The Joint Commission added to its National Patient Safety Goals Requirements ² to ‘Implement a standardised approach to ‘hand off’ communications, including an opportunity to ask and respond to questions’.¹ This initiative directly affected the vast majority of hospitals and at the same time signalled the importance of research investigating how handovers are accomplished and how they could be improved.³ In light
of this interest, we analysed the current practices in postoperative transfer of our paediatric cardiac surgery patients and we identified methods to optimise the handover process.

Postoperative paediatric cardiac surgery patients may be unstable and within this population, good communication skills and a quick but efficient handover are absolutely vital. Several studies have investigated handover and care transitions in this particular discipline.\textsuperscript{6–10} Suggested areas for improvement of handover practice included protocols to structure tasks and processes,\textsuperscript{6,7} information transfer checklists to optimise communication\textsuperscript{6–10} and training in team skills and communication.\textsuperscript{5–8} To improve the postoperative handover in our paediatric cardiac surgery unit, we decided to implement a structured information transfer checklist. All previously reported studies\textsuperscript{6–10} have evaluated the introduction of the structured handover tool after a learning period for the involved team members. Some of the success achieved from the handover protocol might therefore be attributable to the development process and participation from the concerned parties. Furthermore, to be universally applicable and sustainable, it is important that any change in practice is easy to accomplish, without the requirement for additional training. The objective of the present study, therefore, was to evaluate the clinical handover of paediatric cardiac surgery patients from the operating room to ICU before and after the implementation of a structured communication tool, when no team training was provided, and with the involved care teams blinded to the objective of the observations. Our hypothesis was that the implementation of a structured handover tool would improve knowledge transfer.

\textbf{Materials and methods}

\textbf{Patients and procedures}

Ethical approval for this study (Ethical Committee Number 2012/426) was provided by the Ethical Committee of the Ghent University Hospital, Gent, Belgium on 14 August 2012. This prospective interventional study was conducted in the ICU of a tertiary hospital where approximately 150 paediatric congenital cardiac patients undergo surgery each year. All children (age less than 16 years) undergoing cardiac surgery were considered eligible. Written informed consent was obtained from the parents or legal guardian of the child.

Every member of the medical and nursing staff was briefed that an observer (A.K.) would attend the postoperative handover, without revealing the objectives of the observation to minimise the risk of bias. Patients were transferred from the operating room to the ICU whilst sedated. All patients had remained intubated and ventilated with one or more sites of venous access, invasive monitoring and one or more intercostal drains \textit{in situ}. The severity of illness was scored using the RACHS-1 (Risk adjustment for congenital heart surgery) method, which classes risk levels from 1 (low risk) to 6 (highest risk).\textsuperscript{11}

\textbf{Development of the checklist}

We developed a checklist containing all essential elements that, according to the investigators, should be communicated during the handover of a paediatric cardiac surgery patient from the operating room to ICU. The checklist provided patient-specific information, including preoperative history, details of anaesthesia and surgery, and information about the postoperative status (Table 1). The structure of the checklist was derived from a review of the literature,\textsuperscript{6–10,12,13} adapted by the investigators (A.K., A.M., S.D.H.) to create a specialty-specific version that met the particular requirements of our own department. In order to reduce potential bias, the aim of the study was not revealed, no other parties were involved in development of the information transfer checklist and the study was not discussed with colleagues.

\textbf{Data collection}

All individuals involved in the patient’s care were informed that an observer would attend the postoperative handover, without revealing the purpose of his presence, nor the specific data being collected. In both the pre and post-intervention arm.

\begin{table}[h]
\centering
\caption{Information transfer checklist used by the observer during the pre and postintervention arm}
\begin{tabular}{|l|l|}
\hline
\textbf{Name} & \\
\hline
\textbf{Age} & \\
\hline
\textbf{Weight} & \\
\hline
\textbf{Preoperative data} & Medical history \\
& Allergies \\
& Medication use \\
& Disease \\
& Preop results \\
\hline
\textbf{Ventilation} & Tube size \\
& Tube depth \\
& Ventilation mode \\
\hline
\textbf{Catheters} & Details \\
& Complications \\
\hline
\textbf{Surgery} & Procedure \\
& Cross-clamp time \\
& Bypass time \\
& Complications \\
\hline
\textbf{Pacemaker} & Mode \\
& Heart rhythm \\
\hline
\textbf{Medication} & Antibiotics \\
& Tranexamic acid \\
& Sedation \\
& Inotropy concentration and inotropy dose \\
\hline
\textbf{Diuresis} & \\
\hline
\textbf{Blood products} & \\
\hline
\textbf{Coagulation parameters} & \\
\hline
\textbf{Postop TEE} & \\
\hline
\textbf{pH analysis} & \\
\hline
\textbf{Postop care plan} & \\
\hline
\end{tabular}
\end{table}

\textsuperscript{TEE, transoesophageal echocardiography.}
postintervention phase, the handover was communicated by the operating room anaesthetist. A single observer (A.K.) was responsible for data collection during all pre-intervention and postintervention handovers.

In the preintervention phase, the data transfer during the postoperative handover was evaluated by noting whether each information item on the checklist had been communicated or not.

In the postintervention phase, the operating room anaesthetist was asked to fill in the information transfer checklist and to use it as a guide for information transfer. The objectives of the study and the evaluation criteria were still not revealed. For each information item on the checklist (Table 1), the observer noted whether it was verbally communicated or not.

The two intervention arms were undertaken consecutively with no learning or training period in between. In both pre and postintervention phases, the observer also recorded the number of interruptions, the number of irrelevant data and the number of confusing pieces of information that had occurred during the handover process. Interruptions were noted whenever the anaesthetist’s handover of information was interrupted. This was a broad definition and included everything occurring prior to finishing the verbal update, from asking questions (even if related to the patient), to conversations between other members of the care team, patient related or not. Irrelevant was defined as ‘extraneous conversations or commentaries not pertaining to the subject under consideration’. Confusing was defined as ‘lacking clarity of meaning’, for example ‘the patient was really in trouble’. The duration of data transfer was calculated from the moment all urgent tasks were completed and the patient was transferred safely to the ICU monitoring and ventilation, to the moment handover communication was completed and no further information was required.

In both arms, the key ICU doctor and key ICU nurse were asked four questions, 1 h after admission of the patient to the ICU to evaluate their assessment of the handover. The questions addressed how ready they were to receive the patient, how well organised the handover was, whether sufficient information was provided and how accurate the handover was. The answers were rated by scoring on a 100 mm visual analogue scale (VAS).

### Results

Twenty-three patients were included in the preintervention arm and 25 patients in the postintervention arm. Patient characteristics are summarised in Table 2. There were no differences between the two arms in the listed variables.

The checklist consisted of 31 items, which the authors considered essential to be communicated (Table 1). After implementation of the information transfer checklist, the overall data transfer increased from 48 to 73% (P < 0.001). Data transfer (percentage) for each information item is presented in Table 3. After implementation of the information transfer checklist, information about the patient details (name, age, weight) increased from 77 to 96% (P = 0.001), and data transfer about the preoperative status (medical history, allergies, medication use, disease, preoperative results) increased from 48 to 69% (P = 0.001). Information about anaesthesia details (ventilation and vascular lines) and surgical details (procedure, cross-clamp time, bypass time, complications) were given in 56 and 35% of the preintervention handovers, respectively. These data increased to 85 (P < 0.001) and 63% (P < 0.001) for anaesthesia and surgical details, respectively. Data transfer about medication use increased from 43 to 74% (P < 0.001). Information about the postcardiopulmonary bypass status (pacemaker mode, heart rhythm, diuresis, blood products given, postoperative bleeding and coagulation, transoesophageal echocardiography details, laboratory values, postoperative care plan) was provided in 41% of the preintervention handovers, and in 63% of the postintervention handovers (P < 0.001).

### Statistical analysis

Sample size calculation was based on an aimed difference in the information points handed over of 20% between the pre and postintervention group. Accepting a two-tailed α error of 0.05 and a β error of 0.8, a total of 40 patients were required. Statistical analysis was performed using the statistical software SPSS Statistics 20 (SPSS Inc., Chicago, Illinois, USA). Distribution of the data was tested for normality using the Shapiro–Wilk test. For all data, normality had been rejected. Therefore, data are presented as median (range). Comparison between the pre and postintervention arms was performed with Mann–Whitney U test for continuous data and with the Chi-square test for categorical data. P values of less than 0.05 were considered significant.

### Table 2 General data of patients in the preintervention and postintervention arms

<table>
<thead>
<tr>
<th></th>
<th>Preintervention arm</th>
<th>Postintervention arm</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients (n)</td>
<td>23</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Age (month)</td>
<td>16 (0.03–148)</td>
<td>44 (0.01–198)</td>
<td>0.27</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>9.7 (2.9–42.0)</td>
<td>15.4 (3.8–68.0)</td>
<td>0.36</td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>19/10</td>
<td>18/7</td>
<td>0.37</td>
</tr>
<tr>
<td>RACHS score</td>
<td>3 (1–6)</td>
<td>2 (1–6)</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Data are expressed as n, or median (range). RACHS, Risk adjustment for congenital heart surgery.
Implementation of the structured handover tool decreased the duration of verbal data transfer from a median (range) of 6 (2 to 16) to 4 min (2 to 19) (P = 0.04) (Table 4). The number of interruptions, irrelevant data and confusing pieces of information did not differ between the two arms.

The median (range) overall handover assessment score by the ICU medical staff did not increase after implementation of the information transfer checklist [from 90 (25 to 100) to 88 (35 to 100), P = 0.48] (Table 5). Significant postintervention improvement was seen in nursing staff assessment scoring [from 81 (0 to 100) to 88 (50 to 100), P = 0.004] (Table 5).

Table 3 Percentage data transfer in the preintervention (n = 23) and postintervention (n = 25) arms

<table>
<thead>
<tr>
<th></th>
<th>Preintervention</th>
<th>Postintervention</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>70</td>
<td>96</td>
<td>0.02</td>
</tr>
<tr>
<td>Age</td>
<td>74</td>
<td>96</td>
<td>0.04</td>
</tr>
<tr>
<td>Weight</td>
<td>87</td>
<td>96</td>
<td>0.34</td>
</tr>
<tr>
<td><strong>Preoperative data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical history</td>
<td>74</td>
<td>100</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Allergies</td>
<td>17</td>
<td>52</td>
<td>0.02</td>
</tr>
<tr>
<td>Medication use</td>
<td>30</td>
<td>72</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Disease</td>
<td>91</td>
<td>84</td>
<td>0.87</td>
</tr>
<tr>
<td>Preop results</td>
<td>26</td>
<td>96</td>
<td>0.54</td>
</tr>
<tr>
<td><strong>Ventilation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tube size</td>
<td>43</td>
<td>96</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Tube depth</td>
<td>35</td>
<td>84</td>
<td>0.01</td>
</tr>
<tr>
<td>Mode</td>
<td>70</td>
<td>80</td>
<td>0.54</td>
</tr>
<tr>
<td>Complications</td>
<td>48</td>
<td>72</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Catheters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Details</td>
<td>83</td>
<td>92</td>
<td>0.41</td>
</tr>
<tr>
<td>Complications</td>
<td>71</td>
<td>84</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Surgery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedure</td>
<td>74</td>
<td>72</td>
<td>1.0</td>
</tr>
<tr>
<td>Cross-clamp time</td>
<td>4</td>
<td>72</td>
<td>0.01</td>
</tr>
<tr>
<td>Bypass time</td>
<td>0</td>
<td>64</td>
<td>0.01</td>
</tr>
<tr>
<td>Complications</td>
<td>61</td>
<td>44</td>
<td>0.26</td>
</tr>
<tr>
<td><strong>Pacemaker</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode</td>
<td>39</td>
<td>56</td>
<td>0.26</td>
</tr>
<tr>
<td>Heart rhythm</td>
<td>35</td>
<td>52</td>
<td>0.26</td>
</tr>
<tr>
<td><strong>Medication</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotics</td>
<td>61</td>
<td>100</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Tranexamic acid</td>
<td>8</td>
<td>60</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Sedation</td>
<td>48</td>
<td>68</td>
<td>0.24</td>
</tr>
<tr>
<td>Inotropy conc</td>
<td>26</td>
<td>56</td>
<td>0.04</td>
</tr>
<tr>
<td>Inotropy dose</td>
<td>74</td>
<td>88</td>
<td>0.28</td>
</tr>
<tr>
<td><strong>Diuresis</strong></td>
<td>43</td>
<td>48</td>
<td>0.78</td>
</tr>
<tr>
<td>Blood products</td>
<td>74</td>
<td>84</td>
<td>0.49</td>
</tr>
<tr>
<td>Coagulation</td>
<td>39</td>
<td>80</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>Postop TEE</strong></td>
<td>30</td>
<td>76</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>pH analysis</strong></td>
<td>39</td>
<td>80</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>Postop care plan</strong></td>
<td>26</td>
<td>28</td>
<td>0.57</td>
</tr>
</tbody>
</table>

Data are expressed as percentages. TEE, transoesophageal echocardiography.

Discussion

In the present study, we demonstrated that the implementation of a structured communication handover tool improved knowledge transfer from the operating room to ICU, with a shorter handover duration. This simple handover tool was developed to the specific needs of our department, with expertise from our own centre, and its implementation did not require any training, indicating that other areas of medicine might benefit from similar approaches.

In light of the Joint Commission international accreditation standards, we evaluated the postoperative handover process of paediatric cardiac surgery patients in our hospital and identified possible strategies for improvement. Strategies for well tolerated and effective postoperative handovers have been extensively described. After a pilot study, we deemed our current handover process to be already highly effective: all equipment was prepared and functional before arrival of the patient on ICU; all relevant members of the operating room and ICU teams were present during the handover; upon arrival on ICU, everyone focused on his/her own well defined task; and verbal transfer of data was only started when all urgent tasks were completed and the patient was transferred safely onto the ICU monitoring and ventilation. From this pilot study, we concluded that only the communication aspects of the transfer had the potential for improvement. Verbal information transfer was considered to be unstructured, with a great variability in the content and clarity of information transferred. On the basis of previous published work, our study demonstrated improved data transfer after implementation of a structured communication tool. However, contrary to previous studies, this improvement was accomplished without any training period, indicating that the availability of a checklist to guide information transfer significantly improves data transfer. In light of sustainability and the applicability to other areas of medicine, this is an important novel contribution of our work.

Some data, however, remained inconsistently reported. We assume that this is due to the abundance of information transferred, and therefore, the anaesthetist omitted those data that he/she considered as less essential. Remarkably, data transfer about the surgical procedure and complications did not increase after implementation of the checklist. This underlines the need for participation of the surgeon in the handover process to assure completeness and accuracy of information conveyed. Given its importance, the overall low score of the postoperative care plan is worrying. We assume that this might be due to the unique aspects of
Table 5 Assessment of data transfer by intensive care medical staff and nurse staff in the pre and postintervention arm

<table>
<thead>
<tr>
<th>Assessment of data transfer</th>
<th>Preintervention arm</th>
<th>Postintervention arm</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>How ready were you to receive the patient?</td>
<td>85 [25–100]</td>
<td>80 [0–100]</td>
<td>82 [35–100]</td>
</tr>
<tr>
<td>How well organised was the handover?</td>
<td>88 [50–100]</td>
<td>79 [0–100]</td>
<td>88 [50–100]</td>
</tr>
<tr>
<td>Was sufficient information provided?</td>
<td>92 [25–100]</td>
<td>82 [0–100]</td>
<td>90 [40–100]</td>
</tr>
<tr>
<td>How accurate was the handover?</td>
<td>95 [63–100]</td>
<td>89 [0–100]</td>
<td>91 [40–100]</td>
</tr>
<tr>
<td>Overall assessment</td>
<td>90 [25–100]</td>
<td>81 [0–100]</td>
<td>88 [35–100]</td>
</tr>
</tbody>
</table>

Data are expressed as median [range]. MD, medical doctor.

paediatric cardiac surgery, wherein patients’ changing condition demands continuous evaluation and adjustment of the care plan, and to the fact that in our centre, the care for postcardiac surgery paediatric patients is provided by staff members. Therefore, implementing a care plan upon arrival on ICU might have seemed unnecessary to the operating room anaesthetist.

In all cases, the information transfer checklist was 100% completed by the operating room anaesthetist and was left with the patient. The written handover has a different role than the verbal handover. It is a reference tool for the verbal communication at the time of the handover, and it offers the opportunity for the receiving staff to check data that were not verbally communicated or that were not acquired during the handover while multitasking. Electronic handovers might improve legibility and reduce information omissions through the use of standard fields, but they also have inherent limitations, potentially increasing rather than decreasing miscommunications. However, it is important to recognise that a successful handover cannot be achieved with an isolated written report. Effective verbal communication remains important to ensure proper transmission of information and to allow for ‘discussions’ that are essential to create a shared understanding of the situation.

In contrast to previous reports, the duration of the verbal handover in the present study was significantly reduced after the implementation of the information transfer checklist. The duration of the handover was also shorter than other studies. This is due to the fact that we only rated the verbal aspects of the handover, and therefore, the duration of data transfer was only calculated from the moment all urgent tasks were completed.

We observed no difference between the pre and postintervention quality of data transfer (number of interruptions, irrelevant data and confusing pieces of information). This finding is in contrast with previous reports, but can be attributed to the specific situation of the present study. As mentioned before, after a pilot study, we deemed the handover process before implementation of the checklist to already be highly effective. From the data analysis, it appeared that in the preintervention group, quality of data transfer already scored high, and therefore, it was unlikely that the treatment effect would result in a significant improvement. The high preintervention scores reflect the specifics of our working environment, with a vast team of highly specialised healthcare providers, wherein everyone has their own well defined tasks, and wherein the handover process was already highly structured and standardised. As pointed out in a recent editorial, handover quality has to be considered as a multidimensional concept, and to improve the handover process, not only the verbal data transfer but also the setting and institution-specific aspects of handover must be taken into account.

Some limitations of the present study have to be considered. Our patients were not randomised into groups with or without the checklist. It was deemed that it would have been impossible to obtain an objective evaluation of data transfer before and after the implementation of the checklist if members of the care team were aware of the evaluation criteria. Therefore, the two arms were evaluated consecutively. The sample size calculation was based on the change in the information points handed over. The present study was not powered to determine whether implementation of an information transfer checklist could also improve clinical outcome. To date, there are no randomised controlled trials that have shown that excellent data transfer is associated with improved clinical outcomes. However, several studies have demonstrated the relationship between poor data transfer and worse patient outcome.

The questionnaire evaluating the assessment of the handover by the ICU team was completed by the key receiving ICU doctor and nurse of the patient. Therefore, during the whole study period, some doctors and nurses completed the questionnaire multiple times, which might have introduced bias. In addition, the fact that in the preintervention arm, some nurses rated the assessment of data transfer as zero questions the validity of the rating system we used. It highlights the need for adequate measures when rating the handover quality, taking into account the time of the assessment, the level of experience of the healthcare provider and task-related, situational and organisational factors, which all might influence assessment scores. The present study also has the inherent limitations of potential bias by the observer, and by the awareness of the team members that the handovers were being observed. We tried to limit observer bias by ensuring that the same observer was present during all handovers. To minimise the risk of bias from awareness of the team members, every member was briefed that an observer...
Use of a standardised checklist during postoperative handover


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would attend the postoperative handover, without revealing the objectives of the observation.

Although this is a small study in a specific area of medicine, the simplicity and ease of the implementation of an information transfer checklist may also inform other areas of medicine, in order to improve the handover process throughout the care system. It was particularly encouraging to observe that after completion of the present study, the information transfer checklist continues to be used for handovers in our institution. Indeed, the handover tool that was initially developed for paediatric patients was spontaneously adopted by the operating room anaesthetist for communication handover of the adult cardiac surgery patients. The checklist has been revised twice since the completion of the present study, once by optimising its layout by making it a one-page tool, and once to provide more blank space.

In conclusion, the implementation of an information transfer checklist to guide information exchange during the handover of postoperative paediatric cardiac surgery patients resulted in a more complete transfer of information, with a decrease in the handover duration.

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Conflicts of interest: none.

Presentation: none.

References


