Evidence-Based Quality Improvement: A recipe for improving medication safety and handover of care

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CHAPTER 9

Safe and effective nursing shift handover with NURSEPASS

An interrupted time series

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Submitted
ABSTRACT

Background
An effective handover process is complex and essential to ensure continuity and safety of care. To develop a complex quality improvement intervention into maturity a stepwise approach with pilot studies and quasi-experimental designs is recommended by the Medical Council of Research (MRC). In a pilot study we tested an evidence-based and locally developed nursing shift handover blueprint.

Objectives
We aimed to (1) estimate the effect size on quality improvement of the handover with the handover CEX-instrument which consists of 6 subdomains, (2) determine the ability of a bedside safety check to detect discrepancies in expected and actual clinical situation, and (3) gather experiences about feasibility, acceptability and implementation of the handover blueprint.

Methods
A mixed methods design was used. An interrupted time series analysis with three pre and three post intervention periods was used to analyze the effect of the blueprint on handover quality. Descriptive statistics were used to analyze the discrepancies that were intercepted by the bedside-safety-check. Focus groups with nurses were used to gather experiences.

Results
We observed a continued trend of improvement in handover quality and a significant improvement for two domains: organization/efficiency and contents. The bedside safety check was successful in identifying discrepancies on e.g. drains, intravenous medications, bandages or general condition. Nurses judged the blueprint feasible and acceptable, especially the bedside safety check was appreciated and highly recommended for implementation.

Conclusion
The MRC framework enabled us to develop and pilot test the handover blueprint. The blueprint appeared feasible and acceptable. The next step is to evaluate the effectiveness in a large scale interrupted times series or statistical process control; the found effect-size can be used for power calculation. This enables long term measurement on performance and sustainment.
BACKGROUND
Communication failures threaten patient safety, especially at moments when care is handed over from one healthcare professional to another. In an analysis of sentinel events The Joint Commission identified communication and handover failures as a contributing cause in two out of every three sentinel events. In the report, ‘Crossing the Quality Chasm’ the Institute of Medicine (IOM) stated that handovers provide an opportunity for error and that “in a safe system, information is not lost, inaccessible, or forgotten in transitions”. In a 2009 hospital survey on patient safety culture, health-care professionals reported that “important patient care information is often lost during shift changes and patient transfers”. If clinically relevant information is shared accurately and in a timely manner, it may prevent adverse events, inappropriate treatment and delay and omission of care. Global initiatives on handover, as well as accreditation bodies, promote standardization of the handover process to enhance continuity of care and patient safety. During the past decade many organizations responded to this call and initiated quality improvement (QI) projects to standardize the handover process.

Local problem
Nursing shift handover is one of the communication moments when adequate communication is critical for continuity and safety of care, especially nowadays as the amount of information shared during handovers has increased due to risen complexity of care in our hospital. No formal handover policy existed in our hospital, neither for nursing or physician shift handover nor for other handover moments like transfers from or to the Emergency Department, Intensive Care Units or Operating/Recovery Rooms. Since nurses are present on the department both day and night and they are often the (in)formal coordinators of the increasingly complex care that is given within hospitals they are pivotal in ensuring continuity of care. Therefore, we chose the nursing shift handover for an applied research project. We interviewed 13 senior nurses of different departments to (1) find out what kind of handover styles were used in our hospital, and (2) whether they were satisfied with the way handover was conducted. We found large practice variation in handover styles, however reading the nursing files by the incoming nurses and requesting clarification from the leaving nurse if necessary, was the most common handover style. Most departments did not use a predefined structure and if a structure was used, predominantly that of the tracts (nervous system, respiratory system, circulatory
system, digestive system, etc.) was applied. The majority of the departments acknowledged the importance of handover to ensure continuity and safety and was positive about changing and improving the handover style. They indicated a preference for a predefined structure for three reasons: easy access to information, uniformity through a shared mental model of content and order, and improved ability to take over the responsibility for a patient. We concluded there was a sense of urgency and willingness to change and improve the nursing handover. This was further supported by the upcoming JCI re-accreditation, where handover was identified as an improvement issue.

**Intended improvement**

The handover process is complex. Complex interventions are characterized by multiple interacting components, required behaviors of those delivering or receiving the intervention and a variability of outcomes to evaluate feasibility, acceptability and effectiveness of the intervention. For a complex intervention to develop into maturity a stepwise, iterative approach with field tests, pilot studies and quasi-experimental designs as described in the Medical Research Council (MRC) framework is recommended. Figure 1 reflects our approach with an applied research project in the MRC framework.

Our first step was to determine the best available evidence on the most effective nursing handover style through a systematic review. The next step was the development of a new handover process that was evidence-based and tailored to the local situation. Results from the literature were combined with the insights of 20 nurses of different departments in an iterative three round evidence-based consensus process. This resulted in a local nursing shift handover blueprint consisting of 18 recommendations for handover: one recommendation on how to handover (e.g. structured), 12 recommendations on what to handover (e.g. minimal dataset and safety check at the bedside), three recommendations on where to handover (e.g. quiet location) and two recommendations on the preconditions for an effective handover (e.g. communication verification and training). The recommendations were bundled in a ‘nursing shift handover blueprint’ (from here on referred to as ‘handover blueprint’) and structured with the mnemonic NURSEPASS (Figure 2). (unpublished data).
Figure 2. Blueprint Nursing shift handover AMC

This evidence-based blueprint for nursing shift handover in the AMC was developed through combining evidence from the literature with expert opinion of nurses. Through a consensus process, agreement was reached on the ‘HOW’, ‘WHAT’, ‘WHERE’ and ‘PRECONDITIONS’ of the nursing shift handover.

HOW: Nursing shift handover style

A structured written format, which is available in the electronic medical record, is used for each shift handover. For the change of shift from day to evening, as well as for patients with an indication in the other shifts, it is preferred to combine the written handover with a verbal explanation. Preferably this combined written and verbal handover takes place first and if needed, can be supplemented by further reading the medical record afterwards. Each department determines the criteria for patients that have an indication for a combined written and verbal handover, because this is highly dependent on the type of patients.

WHAT: Contents structured format nursing shift handover

Minimal dataset*

<table>
<thead>
<tr>
<th>N</th>
<th>Name and identification of patient</th>
<th>Name, date of birth, gender, allergies, resuscitation status, isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Care providers</td>
<td>Attending physician, surgeon, other caretakers</td>
</tr>
<tr>
<td>R</td>
<td>Reason for admittance</td>
<td>Reason for admittance, relevant history, diagnosis, relevant co-morbidity</td>
</tr>
<tr>
<td>S</td>
<td>Situation</td>
<td>Relevant results of examinations and treatment (laboratory results, radiology, etc)</td>
</tr>
<tr>
<td>E</td>
<td>Evaluation</td>
<td>Vital parameters, pain</td>
</tr>
<tr>
<td>P</td>
<td>Plan</td>
<td>Treatment plan, multidisciplinary treatment goals and evaluation, planned discharge date</td>
</tr>
<tr>
<td>A</td>
<td>Actions</td>
<td>Assignments and tasks</td>
</tr>
<tr>
<td>S</td>
<td>Summary</td>
<td>Summary and verification</td>
</tr>
<tr>
<td>S</td>
<td>Safety check at the bedside</td>
<td>(High risk) medication, pumps, drains, catheters and bandages</td>
</tr>
</tbody>
</table>
Figure 2. Continued

**WHAT:** Contents structured format nursing shift handover

The complete minimal dataset is presented in the structured written report and generated as much as possible from data in the electronic medical record. The structured written report serves as guidance for the verbal handover. The content of the verbal explanation is left to the professional expertise of the nurses.

**WHERE:** Locations for the elements of the nursing shift handover

Handover takes place at a quiet location that enables sufficient privacy and minimal interruptions. Following handover a bedside safety check is performed for indicated patients (high risk) medication, pumps, drains, catheters and bandages. The departing nurse informs the patient about the shift change and the nurse who takes over. Departments can decide to perform the complete handover at the bedside.

**PRECONDITIONS:** Important preconditions for handover

During handover the nurse makes use of verification mechanisms and there is opportunity to ask questions. Senior nurses are trained in the process of handover to enable them to act as role models and teachers.

* The letters of the mnemonic NURSEPASS correspond to Dutch terminology for the categories of the minimal dataset.

The third step was to test the handover blueprint in a pilot study, which is reported in this article. In this study we addressed the following questions. (1) How large is the effect size of the handover blueprint on the quality of nursing shift handover? (2) How many and what kind of discrepancies between expected and actual clinical situation are overcome with a bedside safety check? (3) What are the nurses’ experiences with the feasibility, acceptability and implementation of the handover blueprint?

**Methods**

**Setting**

The study was conducted at the Academic Medical Center (AMC), a large tertiary care university hospital in Amsterdam, The Netherlands. We implemented the handover blueprint on two departments: a cardiothoracic surgery ward and a general internal medicine ward. The nurses work in three shifts of eight hours and each nurse has designated patients. The available
time for shift handover varies from 15 minutes to one hour, depending on the time of shift change and the available overlap time for incoming and outgoing nursing shifts. On the cardio-thoracic department the handover style was a combination of verbal handover and reading the patient record. The internal medicine department is composed of an acute care unit that applied a verbal handover style and a regular internal medicine unit where reading the patient record was used as handover style.

**Study design**
We gathered both quantitative as well as qualitative data on the introduction of the nursing handover blueprint. To evaluate the effect of the introduction of the handover blueprint on the quality of the handover, we used an interrupted time series (ITS) design. We designed our ITS and analysis according to the EPOC recommendations and measured the quality of handover three times before the intervention and three times after the intervention. In the post intervention phase we also examined the potential of the bedside safety check to overcome discrepancies between the expected and the actual clinical situation, through data collection on the occurrence of discrepancies. To gather nurses’ experiences about feasibility, acceptability and implementation we conducted focus groups sessions with the participating departments.

**Ethical approval**
Ethical approval was not considered necessary by the Institutional Review Board of the Academic Medical Center at the University of Amsterdam. This is in accordance with the Dutch Medical Ethics Law.

**Intervention**
The intervention consisted of the nursing handover blueprint itself as well as a bundle of implementation activities to achieve the required behavior change in the nursing teams. From implementation literature it is known that a leading role model, reminders and audit and feedback are effective implementation strategies. Therefore, we asked a senior nurse with a delegated focus on quality and safety of each pilot department to commit to a leading role for the implementation activities. In association with the senior nurse we facilitated a bundle of implementation tools and activities. For educational purposes a generic clinical lesson was available which was tailored to the department’s situation by the senior nurse. The clinical lesson contained (1) the rationale and evidence underpinning the need...
to change handover practice, (2) department specific examples situations where handover was suboptimal resulting in incidents and suboptimal care, (3) the contents of the handover blueprint itself and (4) the departments medical criteria for patients that were indicated for the bedside safety check (e.g. iv medications or first day post-surgery). Furthermore, several generic reminder tools were provided: (1) a pocket reference card and (2) a poster with the elements of the dataset and the bedside safety check, and (3) an announcement of the new handover practice in mailings and newsletters to the team. The latter was tailored by the senior nurse to their department organizational culture. The senior nurse also recruited two or three additional senior nurses as buddies for this project and through reinforcement they jointly ensured continuing attention of the team for applying the handover blueprint.

In a 5-day implementation week the clinical lesson was given on multiple occasions, pocket reference cards were handed out and the posters were mounted at the physical locations of handover. The implementation week was followed by three alternating measurement weeks. After each measurement week we provided and discussed the preliminary results with the senior nurse who subsequently communicated the results to the team as an audit and feedback strategy.

Data collection
To estimate the effect of the handover blueprint on the quality of the handover we used the CEX-instrument developed by Horwitz et al. With this instrument the handover is evaluated on six categories with a nine-point Likert scale: (1) setting, (2) organization/efficiency, (3) communication skills, (4) content, (5) clinical judgment, (6) professionalism (Appendix 1). Although the CEX-instrument was developed and validated for use by an independent observer, we adapted the form for assessment by the incoming nurse (the nurse that receives the handover). Two researchers (MS and HV) translated the instrument independently from English to Dutch and a third researcher with a clinical nursing background (PV) made the final decision on the preferred translation. Each measurement period lasted one week, in which nurses filled out the CEX-instrument after receiving handover (one evaluation per patient handed over). We strived to obtain at least 100 evaluations of the handover per measurement period according to the recommendation of Wagner. We alternated the measurement weeks with one week without measurement.

For patients that were indicated for a bedside safety check according to
the departments criteria, we asked the nurses to document if the result of the bedside safety check was in accordance with the expectation after handover and if not, which items were aberrant (Appendix 2) Data on the bedside safety check were collected in the three post implementation measurement weeks.

The pilot study was concluded with two focus group sessions with representatives from the pilot departments. Both sessions were moderated by MS and HV. neither had a hierarchical relationship with the nurses present. The senior nurse responsible for the implementation organized the session and invited the nurses to participate and she was present as well. The sessions were held on the department and recorded with the permission of the participants. In the sessions we elicited opinions on: (1) the feasibility and acceptability of the handover blueprint and bedside safety check (criteria for indicated patients, feasibility and added value), (2) experienced barriers and facilitators for implementation.

**Data analysis**

For the analysis we assumed that a handover of high quality would receive high scores on the nine-point Likert scales and a handover of poor quality would receive low scores. Therefore, we hypothesized that after implementation of the handover blueprint the percentage of high scores would increase and the number of low scores would decrease. We recalculated the data and qualified a score of eight or nine as high, a score between five and seven as average and a score between one and four as low. Next we analyzed if there was an increase and/or decrease in the percentage of high and low scores between the three time periods before and the three time periods after the implementation. An autoregressive integrated moving average (ARIMA) model was used to evaluate the data on the quality of the handover. A two-sided p-value<0.05 was considered statistically significant.

The effect of the bedside safety check was analyzed with descriptive statistics: the number of patients indicated for safety check, the number of safety checks where the clinical situation was according to handover, the number of safety checks with discrepancies and the number of safety checks that were not done.

All data was entered by MS and checked by HV. For the analyses of handover quality and the effect of the bedside safety check we used IBM SPSS statistics version 18.0 (SPSS Inc., Chicago, IL, USA).
RESULTS
The three pre intervention measurement weeks were in March-April 2015, the two week implementation period took place in April 2015 and the three post intervention measurement weeks were in May-June 2015. In total we included 1175 shift handovers in the study (n=561 pre intervention, n=614 post intervention). In the three pre intervention measurement weeks the nurses evaluated respectively, 185, 198 and 178 handovers in the three post intervention measurement weeks they evaluated 203, 205 and 206 handovers. We had missing data on one or more of the quality of handover scores in 126 cases (1.8% of all scores) and these scores were left out of the analyses. We recalculated the scores to classify them as high, average or low (Table 1). Post intervention we had missing data on the indication for the safety check in 35 cases (5.7%) and on the conformity of the safety check with the information handed over in 12 cases (12%).

Table 1. High and low scores per category

<table>
<thead>
<tr>
<th></th>
<th>Pre intervention</th>
<th>Post intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>232</td>
<td>75</td>
</tr>
<tr>
<td>Average</td>
<td>1695</td>
<td>1636</td>
</tr>
<tr>
<td>High</td>
<td>1389</td>
<td>1861</td>
</tr>
</tbody>
</table>

Quality of handover

High and low scores overall
Trends of percentages high and low scores for the quality of handover are presented in Figure 3 and the parameter estimates are summarized in Table 2. The baseline percentage of high scores was estimated to be 27.33% and the baseline percentage of low scores was estimated to be 6.93%. The pre intervention period showed an increase in high scores by 713% and an increase of low scores by 0.1%. Right after the start of the interventions we observed an immediate decrease of high scores by -12.7% (p=0.05) and -4.38% (p=0.09) for the low scores. There was no significant change in post intervention slopes.

High and low scores per category
We also analyzed the trends of percentages high and low scores for the quality of handover per category. No significant changes were observed in the percentages of high scores. In the category organization/efficiency the
Figure 3. Percentage of high and low scores for quality of handover
Table 2. Interrupted time series analysis. % high and low scores for quality of handover

<table>
<thead>
<tr>
<th>High Scores</th>
<th>$\beta$ (SE)</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept ($\beta_0$)</td>
<td>27.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope pre intervention ($\beta_1$)</td>
<td>7.13</td>
<td>2.02 to 12.24</td>
<td>0.04</td>
</tr>
<tr>
<td>Level change after intervention ($\beta_2$)</td>
<td>-12.70</td>
<td>-26.02 to 0.66</td>
<td>0.05</td>
</tr>
<tr>
<td>Slope difference ($\beta_3$)</td>
<td>0.18</td>
<td>-5.92 to 6.28</td>
<td>0.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low scores</th>
<th>$\beta$ (SE)</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept ($\beta_0$)</td>
<td>6.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope pre intervention ($\beta_1$)</td>
<td>0.10</td>
<td>-2.95 to 3.15</td>
<td>0.76</td>
</tr>
<tr>
<td>Level change after intervention ($\beta_2$)</td>
<td>-4.38</td>
<td>-12.33 to 3.57</td>
<td>0.09</td>
</tr>
<tr>
<td>Slope difference ($\beta_3$)</td>
<td>-112</td>
<td>-4.77 to 2.53</td>
<td>0.16</td>
</tr>
</tbody>
</table>

$\beta_0$ is the baseline; $\beta_1$ estimates the pre intervention slope; $\beta_2$ estimates the difference between the observed level just after the intervention started and that predicted by the pre intervention slope; $\beta_3$ estimates the difference in slopes between pre intervention and post intervention period.

Percentage of low scores reduced immediately after the intervention with -7.03% (p=0.05) and with a significant decrease of the post intervention slope -6.35% (p=0.03). This trend was the same for the category contents with a -5.32% (p=0.02) decrease immediately after the intervention and a -3.75% (p=0.02) for the post intervention slope. For the other categories no significant changes were found.

**Effect of bedside safety check**

In the period after implementation 247 (40.2%) of the handovers were indicated for a bedside safety check. In 185 cases (74.9%) the clinical situation was conform expectation, 32 (13.0%) of the indicated safety checks were not done and in 25 (10.1%) cases one or more discrepancies were reported. This resulted in a total of 31 discrepancies divided over six categories: Drains (10/31; 32.2%), intravenous medications (9/31; 29.0%), bandages (3/31; 9.7%), equipment findings (2/31; 6.5%), general condition (1/31; 3.2%) and other findings (6/31; 19.4%) of which four findings on external pacemakers from cardiothoracic surgery.
Nurses experiences
Two sessions were held, one on each department with eight participating nurses. The sessions lasted approximately 45 minutes. The introduction of a structured handover was not perceived as a major change, but more as a further refinement of the existing handover process. The nurses mentioned that the extra attention for structure and contents enabled them to efficiently handover and only discuss the relevant items. For setting a norm on good quality handover they indicated that at least 80% of handovers should score an eight or nine. When asked what makes a good quality handover (a score of eight or nine) the response of the nurses was:

“I can start my shift without having to do additional reading.”

The introduction of the bedside safety check was very much appreciated by the nurses. They perceive the check as a valuable tool to improve nursing shift handover and indicated that it felt like a common-sense activity that is essential for good quality care. For the leaving nurse it functions as a formal moment of actually handing over the (responsibility of) care. For the incoming nurse it provides an immediate and clear picture of the patient at the start of the shift, also enabling the nurse to adequately judge any change of the condition of the patient later on in the shift. Also some nurses mentioned that as a consequence of the safety check documentation on for instance drains improved. The chosen criteria for indicated patients were judged as adequate on both departments. Some nurses mentioned that during the safety check some additional items of handover were discussed at the bedside as well, which increased the feeling that bedside handover is feasible in the future. The only barrier to the bedside safety check was the time needed for shift change at night and in the morning (15 minutes), which sometimes caused overtime.

On implementation they valued the clinical lesson, reinforcement of the new practice by their own senior nurses and audit and feedback information from the evaluations.

DISCUSSION
In this pilot study we implemented a handover blueprint with bedside safety check on two nursing departments of an academic hospital to determine the effect size on quality of handover. After implementation we observed a continued trend of improvement in handover quality. In the categories
organization/efficiency and contents of the handover we saw a significant decrease of low scores. Since these were two topics that were specifically targeted by the handover blueprint, this may explain the positive effect. The time series analysis can be used to analyze quality of handover as an outcome measure, however our pre and post measurement periods were too short to assess conclusive results on the effectiveness of the nursing handover blueprint. Therefore, for the next step in the MRC framework we recommend a larger scale evaluation with a longer period of data collection in an interrupted time series or statistical process control design. These methodologies both provide more reliable results than traditional QI design with before and after measurement and it also enables the monitoring of the sustainment of the intervention.\textsuperscript{26-28} In a recent publication by Jandoc a minimum of nine data points pre intervention, post intervention and at least 100 observations per data point is encouraged. Also a clear intervention time point is recommended to identify pre intervention and post intervention data points and for gradual or delayed intervention effects, a lag period may be considered.\textsuperscript{29} In our analysis we observed a rather large decrease in high scores immediately after implementation, this might be explained by the extra attention of the implementation period resulting in a more critical judgments of handover quality in the first measurement week after implementation.

The use of the handover blueprint was perceived as an improvement and refinement of the existing handover process. Especially the introduction of the bedside safety check at shift handover was highly appreciated. Besides the available verbal and written information on the patient from handover, the visual check of the patient’s clinical situation as well as the checking of IV medications, equipment, drains and bandages gave the nurses a more complete clinical picture and a well prepared feeling at the start of their shift. We also saw that the safety check intercepted errors or situations that might lead to an error, because of the safety check these situations were detected early.

In our consensus study on the development of the handover blueprint (unpublished data), bedside handover was rejected because it was deemed not possible by the majority of the nurses. However, bedside handover is considered current best practice because of the opportunity to reduce errors and increase patient engagement.\textsuperscript{30} As a consequence of the practical experience with the bedside safety check, it appears that barriers for full bedside handover are decreasing on the two departments. Therefore, the introduction of a bedside safety check may serve as a valuable enabler
for the process of change towards full bedside handover in our hospital. Through the stepwise approach with a pilot implementation according to the MRC framework, we were able to find out some essential ingredients for implementation as well as evaluation of the nursing handover blueprint. For the implementation of the changes in the nursing shift handover process, the involvement of leading senior nurses was indispensable. Their joint leading position on informing and reinforcing the team on the new practice was perceived as a major success factor. Also the audit and feedback was valued as an implementation tool. The CEX-instrument which we used to measure the quality of handover was adequate and feasible to fill out. Nurses had no trouble filling in the instrument, however regular reminders during a measurement period to do so, are needed. For practice the instrument can also be used as an individual feedback or learning tool for students or in induction programs of newly employed nurses or even as periodic measure as a nursing sensitive quality indicator.

Limitations
This single center pilot study implemented a local handover blueprint. The content of the handover blueprint is not easily generalized to other institutions, but the applied approach and steps taken can be used by others. We used the EPOC recommendations for our ITS design and analysis, however during our study the recommendations of Jandoc became available. These recommendations are more extensive and can serve as reference for future studies. The validated CEX instrument was developed for assessment by an independent observer, we asked the nurse that receives the handover to assess the quality and therefore validity of the instrument cannot be guaranteed in our situation.

Implications for research
The stepwise approach according to MRC framework is recommendable for QI research. For larger scale evaluation, designs that enable interrupted times series or statistical process control is recommendable. For data collection, instruments that are easy to fill out or that make use of existing data sources such as the electronic patient record are recommendable. By limiting the effort needed to acquire the data, longer measurement periods are easier to accomplish and it also enables the evaluation of repeated implementation activities with regular intervals.
Implications for practice
Especially for complex interventions such as handover it is essential to involve local users in the development and implementation of the intervention. To move from old habits and conventions, the use of incentives, such as for instance the bedside safety check, may enable a smooth transition and a stepwise approach towards the desired situation. The audit and feedback strategy is valuable to regularly inform the team of performance and is also invaluable to determine the need for repeated implementation activities which are needed to sustain the desired way of practice.

Acknowledgements
We thank Peter Vink (PV) for assisting in translating the CEX instrument. We thank head nurses Maaike Heinsman and Gwenda Veenboer for participating with their departments and their leadership support for the project. We thank the senior nurses Elisabeth Rouw, Lisa de Boer and Jeanique van de Geest for their help with the implementation and evaluation of the handover blueprint. We gratefully thank all nurses for participating and filling out the 1175 evaluation forms.

Authors’ contributions
HV, study design and supervision; JM, SD, statistical guidance; CD, DA, data collection and implementation; MS, analyses of data; HV, MS, JM, data interpretation; MS drafting the manuscript; all authors, revising the manuscript for intellectual content and final approval.

Competing interest
The authors declare that they have no competing interests.

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## APPENDIX 1.

### Data collection forms

#### Quality of shift handover

<table>
<thead>
<tr>
<th>Evaluation form shift handover</th>
<th>1 form per patient handed over</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Department</strong></td>
<td>————</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>———— 2015</td>
</tr>
<tr>
<td><strong>Name</strong></td>
<td>————</td>
</tr>
<tr>
<td><strong>Experience</strong></td>
<td>————</td>
</tr>
<tr>
<td><strong>Shift</strong></td>
<td>□ less than 1 year □ 1-2 years □ 3-5 years □ more than 5 years</td>
</tr>
<tr>
<td><strong>Setting</strong></td>
<td>1 2 3</td>
</tr>
<tr>
<td></td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td><strong>Organization/efficiency</strong></td>
<td>1 2 3</td>
</tr>
<tr>
<td></td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td><strong>Communication skills</strong></td>
<td>1 2 3</td>
</tr>
<tr>
<td></td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>1 2 3</td>
</tr>
<tr>
<td></td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td><strong>Clinical judgment</strong></td>
<td>1 2 3</td>
</tr>
<tr>
<td></td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td><strong>Professionalism</strong></td>
<td>1 2 3</td>
</tr>
<tr>
<td></td>
<td>Unsatisfactory</td>
</tr>
</tbody>
</table>

### Remarks on handover

- **Setting**
  - >= 5 interruptions:
  - Noisy/chaotic
  - No interruptions:
  - Silent

- **Organization/efficiency**
  - Standardized handover:
  - Concise

- **Communication skills**
  - Face-to-face handover:
  - Confirms understanding
  - Elicits questions
  - Assigns responsibility for tasks
  - Concrete language

- **Content**
  - Includes all essential information
  - Describes clinical condition
  - to do’s have plan
  - rationale

- **Clinical judgment**
  - Sick patients identified
  - Anticipatory guidance provided
  - with plan of action

- **Professionalism**
  - Focused on task
  - Appropriate comments
  - re: patients, family, staff

- **Remarks on handover**
PART II - Safe handover of care

Safety Check

Patient indicated for safety check?
- NO
- YES, fill out the rest of the form

Patient number: ...........................................

SAFETY CHECK according to information that was handed over?

- YES
- NO, indicates which elements of the safety check are aberrant and describe the finding

<table>
<thead>
<tr>
<th>Medication</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Pump readings</td>
<td></td>
</tr>
<tr>
<td>□ Timeliness medication administration</td>
<td></td>
</tr>
<tr>
<td>□ IV line: infection, point of entry</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Oxygen</td>
<td></td>
</tr>
<tr>
<td>□ Suction needs</td>
<td></td>
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<tr>
<td>□ Bel with reach</td>
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<table>
<thead>
<tr>
<th>Drains</th>
<th>Finding</th>
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</thead>
<tbody>
<tr>
<td>□ Catheter</td>
<td></td>
</tr>
<tr>
<td>□ Drains</td>
<td></td>
</tr>
<tr>
<td>□ Check of fluid balance</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Bandages</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Signs of infection</td>
<td></td>
</tr>
<tr>
<td>□ Timeliness bandage change</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Vitals</td>
<td></td>
</tr>
<tr>
<td>□ Neurological scores</td>
<td></td>
</tr>
<tr>
<td>□ Fall risk</td>
<td></td>
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<tr>
<td>□ General condition patient</td>
<td></td>
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</tbody>
</table>

Remarks on the safety check