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Human factors in clinical handover: development and testing of a 'handover performance tool' for doctors' shift handovers

CINZIA PEZZOLESI[1], TANJA MANSER[2], FABRIZIO SCHIFANO[1], ANDRZEJ KOSTRZEWSKI[1], JOHN PICKLES[3], NICHOLLS HARRIET[3], IAIN WARREN[3] AND SORAYA DHILLON[1]

[1]School of Pharmacy, University of Hertfordshire, College Lane, Hatfield, UK, [2]Department of Psychology, Industrial Psychology and Human Factors Group, University of Fribourg, Rue P.A. de Faucigny 2, Fribourg, Switzerland, and [3]Luton and Dunstable Hospital, Lewsley Road, Luton, UK

Address reprint requests to: Cinzia Pezzolesi, University of Hertfordshire, School of Pharmacy, Hillside House, College Lane Campus, Hatfield AL10 9BS, UK. Tel: +44-170-728-3548; Fax: +44-170-728-4506; E-mail: c.pezzolesi@herts.ac.uk

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Abstract

Objective. To develop and test a handover performance tool (HPT) able to help clinicians to systematically assess the quality and safety of shift handovers.

Design. The study used a mixed methods approach. In the development phase of the tool, a review of the literature and a Delphi process were conducted to sample five generic non-technical skills: communication, teamwork, leadership, situation awareness and task management. Validity and reliability of the HPT were evaluated through direct observation and during simulated handover video sessions.

Setting. This study was conducted in the Paediatrics, Obstetrics and Gynaecology wards of a UK district hospital.

Participants. Thirty human factor experts participated in the development phase; 62 doctors from various disciplines were asked to validate the tool.

Main Outcome Measures. Item development, HPT validity and reliability.

Results. The tool developed consisted of 25 items. Communication, teamwork and situation awareness explained, respectively, 55.5, 47.2 and 39.6% of the variance in doctors rating of quality. Internal consistency and inter-rater reliability of the HPT were good (Cronbach's alpha = 0.77 and intra-class correlation = 0.817).

Conclusions. Communication determined the majority of handover quality. Teamwork and situation awareness also provided an independent contribution to the overall quality rating. The HPT has demonstrated good validity and reliability providing evidence that it can be easily used by raters with different backgrounds and in several clinical settings. The HPT could be utilized to assess doctors' handover quality systematically, as well as teaching tool in medical schools or in continuing professional development programmes for self-reflective practice.

Keywords: clinical handover, human factors, patient safety, communication, teamwork

Introduction

There is evidence from the literature to support the claim that doctors' shift handovers are characterized by a high level of information corruption and lack of structure [1–5]. Nonetheless, the impact of sub-optimal handover practice has severe consequences for both patients and staff. For patients it often means altered or delayed treatment plans, unclear diagnosis and frequent medication errors [6]. Implications for the medical staff include emotional distress and clinical uncertainty due to the lack of clear instructions on care management [7], which could also make them feel unsupported and not in control of their patients' care. Hence, high-quality handover is of crucial importance to patient safety in hospitals [8]. Despite the growing literature,

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the concept of handover is poorly defined and questions remain as to how best it should be measured.

It has been suggested that quality and safety of doctors' handover depends on both technical and non-technical aspects of their performance [9]. Technical skills refer to procedure-specific skills, whilst 'non-technical skills', as core part of human factors, refer to the cognitive, social and personal resource skills that complement technical skills and therefore contribute to safe and effective task performance [10]. Generic human factors relevant to patient safety include elements of teamwork, situation awareness, decision-making, leadership, task management and communication.

In high-risk industries technical and non-technical skills are routinely assessed [10]. However, in health care, studies on handover have focused almost exclusively on technical performance and in particular on the development of protocols and checklists that define specific information content for particular clinical settings [11, 12] and tools in support to communication standardization. Such tools focus on general interaction structures that do not define the exact content of the information but the topics to be covered during handover. Most of them are adaptations of the classical SBAR tool, such as ISBAR (identify situation, background, agreed plan, read back) [13]; and 'iSoBAR' (identify, situation, observations, background, agreed plan, read back) [14]; but some are more context specific such as the SHARED (situation, history, assessment, risk, expectation, documentation) tool for Obstetrics and Gynaecology handovers [15].

Nonetheless, to ensure patient safety and continuity of care attention to non-technical skills and human factors is necessary since patient handovers require effective teamwork, which involves more than just information transfer [8]. Only a few studies so far have explored handover quality including some measurement of teamwork processes [8, 16–18] but none of these studies explicitly looked at the non-technical skills involved in shift to shift handovers. Thus, there is a need to develop and evaluate an assessment tool able to help clinicians to systematically assess the quality and safety of handovers. The tool would be of value not only in the assessment of qualified doctors but also as an aid in undergraduate education and training. The present study aims to develop and test a handover performance tool (HPT).

Methods

The study was conducted in a medium size general district hospital in the UK following ethics approval of the local National Health Service (NHS) Hertfordshire Research Ethics Committee, The Luton and Dunstable Hospital Research and Development Department and the School of Pharmacy University of Hertfordshire ethics committee. A triangulation of research methods [19] was used to develop and test a performance assessment tool for medical shift handovers taking into account technical as well as human factor aspects. These methods included a literature review, consultations with a panel of experts and validation of the tool in both clinical settings and during simulated handover video sessions.

Item generation

An initial list of items was generated by the principal researcher based on the existing literature on handover rating tools [20–22] and previous research on human factors in health care [23–25]. In particular, some items for information transfer and teamwork were adapted from a rating form for inter-professions and inter-speciality handover [8].

Items were then grouped by the principal researcher into five generic non-technical skill categories:

(i) Communication: items included referred to the quality and quantity of the information exchanged during handover.
(ii) Teamwork: defined as cooperation, coordination and absence of conflicts among members of the team.
(iii) Leadership: includes items on identification of the team leader and management of the communication flow during the handover meeting.
(iv) Situation awareness: comprises items on shared understanding of the current patient situation and consideration of potential future complications.
(v) Task management: included items on allocations and prioritization of activities to be completed by the team receiving the handover.

The Delphi method

A Delphi process [26] was also used to gain consensus about the inclusion of non-technical skill items in an HPT measuring the quality and safety of handover. A panel of experts composed by 30 members (17 doctors, 4 nurses, 1 pharmacist, 5 industrial psychologists and 3 academics/researchers) identified through the UK Clinical Human Factors Group evaluated the HPT items. For each item on the list the participants indicated whether the item should be incorporated into the tool by scoring between 1 (strongly disagree) and 5 (strongly agree). Responses from participants were then analysed and the mean scores and standard deviations were calculated for each item in each round. Rounds were repeated until consensus among the expert panel was achieved. The literature on the Delphi process does not define when consensus can be deemed to have been reached [16]. Therefore, an 80% cut-off value was selected which correlated with a mean score of 4.0. The items which were rated above this value in Round 1 were selected to be included, the rest of them were resubmitted to the panellists with a summary of the results of Round 1. A third round was not required as the predetermined criteria for consensus was achieved and data saturation was reached.

Assessment of validity and reliability of the HPT

Data were collected during 20 observations in two clinical settings (10 in Paediatrics and 10 in Obstetrics and Gynaecology). Each handover meeting was assessed independently by four raters: the doctor handing over, the doctor

taking over the responsibility for the patient and two external observers. All assessments were made immediately after the handover meeting.

Further, extra data were collected during the simulated handover video sessions attended by the consultants from various disciplines in the study hospital. A 10-min handover training video developed by the Salisbury NHS Trust [27], featuring an example of poorly conducted handover ('poor handover' video) and an example of a well-conducted handover ('good handover' video) was shown to the doctors who agreed to take part in the study ($n = 62$). Doctors were then asked to use the HPT to rate both videos.

Data were analysed in order to assess whether the HPT measures the five non-technical skills that it is supposed to measure (i.e. demonstrates construct validity) and does so accurately (i.e. shows good reliability). A principal component analysis (PCA) (promax rotation) was therefore conducted on all ratings of handover in our sample (i.e. by four raters in two clinical settings and from the video sessions). Also, the assessment of reliability was done using Cronbach's alpha to determine the HPT internal reliability and the intra-class correlation coefficient (ICC) to determine the inter-rater reliability of the HPT scales. Finally, the level of association between non-technical skills and the handover quality (i.e. concurrent validity) was computed using multiple regression analysis.

Results

Item generation

The initial draft of the HPT resulted in 21 non-technical items. Two items on accountability and responsibility and a single item for the assessment of the overall handover quality were also added to the tool by the expert panel. Moreover, because time pressure, workload and staffing issues may influence handover quality it was deemed important to include four extra items assessing the circumstances of handover to allow an analysis of their influence on its quality. The total number of HPT items was 28. Each item on the HPT was to be rated on a 5-point scale (1 = strongly disagree to 5 = strongly agree).

Delphi method

Table 1 shows the results of two rounds of the Delphi process. Round 1 resulted in inclusion of 14 items. In Round 2, 14 items were assessed. This resulted in further inclusion of 11 items on the assessment tool. In total, 25 items were included after two rounds (Fig. 1).

Construct validity

Pre-analysis checks showed that factorization of the combined sample of observations and video data ($n = 141$) was appropriate, as indicated by a Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy of 0.793. An initial principal components analysis was conducted on the polychoric correlation matrix. Although the first five components had eigen values of >1, the Cattel's scree test suggested the extraction of only the first three. Thus, three factors, accounting for 66% of the total variance, were extracted.

Factor one 'Communication' explained 37% of the common variance between items (Table 2). Items that loaded most on this factor referred to (a) sharing of information, including the possibility of asking questions (i.e. closing the 'communication loop'; (ii) assessment of the clinical situation including environment and potential patient outcomes. Factor two, 'Teamwork' explained 32% of the overall common variance observed among factors. Items most loading on the second factor were related to positive contact and coordination between clinicians involved in the handover and absence of conflicts. The third factor 'Situation awareness' accounted for 30% of variance and described the tendency to focus the attention on the team briefing and the identification of the sickest patients.

Reliability

HPT internal consistency was computed using Cronbach's alpha based on the clinical observations using ratings by both the doctor handing over and the doctor receiving the handover, and the two external observers in the two clinical specialities ($n = 80$). Figures for alpha are all >0.7 indicating that the reliability of the HPT is acceptable (Table 3). The inter-rater reliability of the HPT scales (communication, teamwork and situation awareness) was fairly good as highlighted in Table 4.

Concurrent validity

Across each of the conditions (natural observations and videos) the scales explained a large amount of the variance in quality rating (39.6–55.5%) (Table 5). Multiple regression analysis showed that communication and teamwork have a sound impact on the way doctors perceived handover quality. In particular, factor 1 'Communication' was the strongest predictor of quality, indicating that for every one unit increase in the rating of communication there was around a half a unit increase in perceived quality (β: 0.53–0.58, $P \leq 0.001$).

Discussion

We have developed and tested the HPT for assessing the human factor aspects of doctors' handover. Our tool was primarily developed because it was deemed important to regard handover as something more than a pure episode of information transfer as many are the factors that influence its quality and ultimately safety. When measuring doctors' handover abilities in current practice, consideration was given to the fact that individual performances are embedded in larger units of activity and purposes and that variation in performance may be shaped by the relationship between individuals and the components of the larger units. Doctors'

Table I Results of the Delphi process—Rounds 1 and 2

	Mean	SD	Result	Mean	SD	Result
Communication						
Clinical information was shared between the outgoing and incoming team	4.17	0.75	I	—	—	—
The handover included enough written information	3.97	0.81	E	4.50	0.75	I
The handover was an opportunity for the person taking on responsibility for the patient to ask question	3.63	0.61	E	4.29	0.66	I
The person taking on responsibility for the patient raised ambiguities	2.53	0.97	E	2.64	0.78	E
The incoming team understood the tasks to be done	3.10	0.92	E	2.82	0.72	E
Unfamiliar members of the team were introduced	4.27	0.83	I	—	—	—
Teamwork						
A good contact was established at the beginning of the handover	3.67	0.71	E	4.25	0.84	I
The outgoing team and the incoming team coordinated with one another to collect relevant information in a systematic manner	4.10	0.99	I	—	—	—
There were tensions within the teams during the handover	3.83	0.65	E	4.18	0.39	I
The team jointly assured that the handover was completed	4.03	0.67	I	—	—	–
Leadership						
The leader of the new responsible team was clearly identified	3.97	0.61	E	4.14	0.45	I
The leader of the outgoing team invited the participants to speak up	3.63	0.49	E	4.18	0.48	I
Situation awareness						
The role and the grade of the team members were stated at the beginning of the handover	3.93	0.78	E	4.43	0.57	I
Concerns about risks to patients were raised	4.83	0.38	I	—	—	—
Patients who were unstable were identified	3.37	0.56	E	2.61	0.50	E
Deteriorating patients were identified	4.60	0.50	I	—	—	—
The outgoing team provided a clear assessment of the clinical situation in which the new team will be working	2.87	0.35	E	4.21	0.57	I
Potential adverse outcomes were discussed	4.37	0.49	I	—	—	—
Actions to prevent adverse outcomes were articulated	4.43	0.77	I	—	—	—
Task management						
Tasks to be completed were clearly assigned to the outgoing team	4.03	0.72	I	—	—	—
The outgoing team provided a clear list of priorities for action for the new team	3.73	0.45	E	4.11	0.50	I
Accountability and responsibility						
The person handing over was always the person who had seen the patient	3.03	0.93	E	4.11	0.79	I
The new person responsible for the patient was made clear	4.73	0.45	I	—	—	—
Quality						
The overall quality of this handover was high	4.07	0.91	I	—	—	—
Circumstances of handovers						
The team handing over was under time pressure	4.30	0.75	I	—	—	—
There were staffing issues affecting the ward	3.63	1.03	E	4.57	0.50	I
The cases that were handed over were of high complexity	4.37	0.76	I	—	—	—
There were interruptions during handover	4.37	0.49	I	—	—	—

I, included E, excluded. Consensus was deemed to have been reached with a cut-off value of 80% which correlated with a mean score of 4.0. HPT items rated above the 80% value in Round 1 were selected to be included in the HPT. Items on which no consensus was reached were resubmitted to the panellists. A third round was not required as the predetermined criteria for consensus (80%) was achieved and data saturation was reached.

performance may in fact be conceptualized as an entity which is complex, multifactorial and non-linear in nature [28]. The HPT items were generated following a review of the literature and panel of experts' consultation which included a Delphi process to identify the key non-technical skills for shift handovers. Such a process resulted in the inclusion of 25 items.

In our study, the non-technical skill that mainly accounted for good handover quality was communication. The importance of communication across various medical domains [29]

HANDOVER Non-Tech skills	1	2	3	4	5	Not Appl.
1. Clinical information was shared between the night & day team						
2. The handover included enough written information						
3. The handover was an opportunity for the person taking on responsibility for the patient to ask questions						
4. Unfamiliar members of the teams were introduced						
5. A good contact was established at the beginning of the handover						
6. The night team and the day team cooperated with one another to collect clinical information						
7. There were tensions within the teams during the handover						
8. The leader of the day team was clearly identified by the night team						
9. The leader of the night team invited the participants to speak up						
10. The role and grade of team members was stated at the beginning of the handover						
11. Concerns about risks to patient care were raised						
12. A general assessment of the environment was performed i.e. assessment of building, equipment and staffing level						
13. Deteriorating patients were identified						
14. Potential patients adverse outcomes were discussed						
15. Actions to prevent adverse outcomes were articulated						
16. The night team provided a clear list of priorities for action for the new team (written or verbal)						
17. Tasks to be completed were assigned to the day team						
18. The person handing over was always the person who had seen the patient						
19. The new person responsible for the patient was clearly identified						
20. The team jointly assured that the handover was complete						
21. The overall quality of this handover was high						
Circumstances of handover						
22. The cases handed over were of high complexity						
23. The team taking the responsibility was under time pressure						
24. There were staffing issues affecting the ward						
25. There were interruptions during handover						

1=strongly disagree; 2= disagree; 3=neutral; 4=agree; 5=strongly agree; Not Appl.=Not Applicable

Figure 1 Final version of the handover performance tool.

and in the context of handover has been previously identified in the literature [5, 14]. There is also abundant evidence of negative consequences of poor communication during handovers such as increased in-hospital complications, preventable adverse events, increased cost, diagnostic test delays and other safety threats [14, 30]. However, it could be argued that the problems with handovers might not just lie in the *content* of information that is communicated (technical skill) but in *how* the information is, or is not, communicated (non-technical skill). It is important for doctors that clinical information is effectively shared between the night and day team and this can only happen if for example, the communication is open and consistent and correctly decoded by the recipient.

It is essential to underline though that other non-technical skills, namely teamwork and situation awareness, were found to be highly correlated with perceived quality of handover. This result compares with the findings reported by Siassakos *et al.* [18] in a cross-sectional study of clinical efficiency in a simulated emergency in Obstetrics and Gynaecology. The authors found that more efficient teams were more likely to exhibit positive team behaviours which related to better handover. A few studies have also emphasized the importance of such non-technical skills for junior doctors in various clinical settings [31, 32]. Further, Catchpole *et al.* [11] pointed out that non-technical skill errors were more frequent than technical errors in paediatric surgery handovers. In contrast, a recent study looking at team behaviours (including communication, coordination, cooperation, leadership and monitoring domains) in a similar post-operative setting found that there was no correlation between such domains as, information omission and patient-specific task errors [8]. However, these findings may be specific to pre- and post-operative handovers.

An unexpected result was that the leadership and task management did not come up as separate underlying dimensions of the tool as expected. On the one hand, this could be due to the fact that the tool is not able to capture those two non-technical skills and other behavioural markers should be used, i.e. to identify aspects of leadership that are not linked to communication. On the other hand, leadership and task management can also be seen as integral dimensions of the overall domain of team behaviours and therefore it might be very difficult to differentiate one from another as they are inter related. As mentioned in Jeffcott [33], handover can be seen as part of the so-called 'clinical

Table 2 HPT-loading factors

Item	Communication	Teamwork	Situation awareness	Variance explained (%)
1	0.218	**0.409**	0.366	63
2	**0.544**	**0.527**	−0.176	69
3	**0.959**	−0.066	−0.132	75
4	0.190	0.326	**0.467**	63
5	−0.030	**0.968**	0.061	96
6	−0.266	**0.890**	0.199	76
7	0.123	**0.807**	−0.432	62
8	0.270	−0.277	**0.665**	58
9	**0.696**	0.016	0.097	58
10	−0.247	0.252	**0.904**	81
11	**0.620**	0.018	0.117	49
12	0.355	0.229	0.137	35
13	0.266	−0.169	**0.717**	69
14	**0.811**	−0.143	0.136	70
15	**0.942**	−0.095	−0.108	72
16	**0.468**	**0.400**	0.152	69
17	0.279	**0.424**	0.279	62
18	**0.572**	0.116	0.147	53
19	−0.072	0.107	**0.777**	62
20	−0.078	**0.894**	0.087	80
Variance explained	37%	32%	30%	

The values ofloading >0.4 are given in bold.

Table 3 Internal consistency of the HPT scales

	n items	Average inter-item correlation	Alpha
Communication	9	0.373	0.843
Teamwork	6	0.288	0.708
Situational awareness	5	0.415	0.780

Table 4 Inter-rater reliability of the HPT scales

	ICC	95% CI
Communication	0.749	0.554–0.944
Teamwork	0.825	0.683–0.967
Situation awareness	0.879	0.777–0.979

microsystem' of patient care [34]. Such microsystems include leadership, safety culture, trust and teamwork aiming to promote reliability and safety within safety-critical systems.

Finally, the reliability of the HPT was also assessed. It was found to have good internal consistency and inter-rater reliability. The latter is a particularly promising finding and provides preliminary evidence that the HPT can be easily used by raters with different backgrounds without requiring extensive training in human factors which has clear resource implication. Moreover, it is vital to make performance assessment mainly a formative activity that needs to be linked to early specific training for clinical handover [35]. Until recently, little attention has been paid to clinical handover in medical curricula and there is a lack of formal education at all levels of training [8]. It is clear that the assessment tool developed here (i.e. the HPT) can be used to fill this gap in the educational sector, for instance, it could be included as part of a battery of assessment tools in medical schools when evaluating students' performances or in hospital setting to evaluate junior doctors' abilities to handover at the beginning of their training period and at the end. The tool could also assist the clinicians in the development of the core handover non-technical skills, i.e. teamwork, situation awareness but also accountability and responsibility. The HPT could also contribute to move the research in quality and safety of handovers. As such, it could be used to evaluate the effectiveness of hospital-based interventions, for example, in pre–post intervention studies which include teaching of core handover technical and non-technical skills; it could also be used to evaluate the effectiveness of simulation trainings aiming to improve handover skills. In addition, as the tool was developed for use in variety of clinical settings and for self-assessment by the clinicians involved in the handover it could also be used as part of continuing professional development (CPD) programmes for self-reflective practice hence

Table 5 Regression analysis for the HPT scales

	Natural observations	Good video	Poor video
Communication	0.53*** (0.28, 0.78)	0.56*** (0.30, 0.82)	0.58*** (0.38, 0.78)
Teamwork	0.71*** (0.35, 1.06)	0.27 (−0.20, 0.73)	−0.27** (−0.45, −0.09)
Sit. awareness	0.12 (−0.11, 0.34)	0.39 (−0.10, 0.87)	−0.04 (−0.17, 0.08)
R2 (%)	55.5	47.2	39.6

The values given in parenthesis are 95% confidence intervals.
*$P < 0.05$.
**$P < 0.01$.
***$P < 0.001$.

forming a critical element of healthcare professionals' portfolio; or piloted to assess the handover skills of other healthcare professionals including nurses and pharmacists. Despite the HPT has not been developed for everyday use by healthcare professionals during the handover meeting but for performance assessment purposes, if for example, the key technical elements of handover are also incorporated, upon further validation in the real clinical setting, it could be used as a cognitive aid for junior doctors.

Conclusions and limitations

The HPT is a tool aiming to systematically assess the quality of shift handovers. Overall, the HPT has demonstrated good validity and reliability, hence providing a methodological advancement in the understanding of human factors in clinical handover. It also represents a powerful teaching tool for medical students or for CPD programmes or piloted with other healthcare professionals. Despite that, it is acknowledged that this study had some limitations.

First, the items developed focus around five main generic non-technical skills. This may have resulted in overemphasizing of some non-technical skills from the researcher and initial expert panel. However, the content of the HPT was further validated using a Delphi process.

The Delphi process has been criticized for not allowing interactive discussion [36], nonetheless face-to-face meetings can be difficult to implement for large numbers of clinicians. As the engagement of physicians was deemed crucial in developing a measure of quality of care performance, this method offered an inexpensive and efficient way of reaching consensus on the non-technical items for shift handovers. The Delphi process also allows combining of knowledge and abilities of an expert group anonymously, hence avoiding domination by the most powerful individuals [37].

Further, a limited sample size was used to validate the construct validity of the tool through exploratory factor analysis. The data collected were clustered within observation type (video versus clinical observations) and only 20 clinical observations were conducted. However, this study reported a preliminary validation of the tool and further multi-setting studies are needed in order to use the HPT as a comprehensive assessment of the quality of clinical handover. The assessment of the handover quality was based on subjective perceptions of the healthcare professionals. Hence, the underlying factors identified here might not generalize to different groups of healthcare professionals not included in the study sample. Additionally, future studies will also need to include measures to allow for comparisons of handover characteristics and objective outcomes.

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