Perception of patient safety differs by clinical area and discipline

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Editor’s key points

- Perception of patient safety is an important component of organizational structure essential to quality improvement, but is complex and difficult to study.
- This study examined the influence of environment (operating theatre or intensive care unit) and discipline on organizational factors (latent risk factors) in four university hospitals using a new survey instrument.
- Differences in perceptions of patient safety between various clinical areas and disciplines are important considerations in designing measures to improve safety.

Background. Current thinking about patient safety emphasizes the relationship between organizational factors, that is, latent risk factors (LRFs) and patient safety. This study explores the influence of the operating theatre (OT), intensive care unit (ICU), and disciplines on ratings of LRFs. If we have an understanding of the contribution made by these factors, we can identify significant points from which we can promote a safe environment.

Methods. Staff in four university hospitals were sent a survey relating to the state of LRFs, which included communication, planning and coordination, design, maintenance, equipment, teamwork, team instructions, housekeeping, situational awareness, hierarchy, and procedures.

Results. The ICU staff had more favourable perceptions of training, communication, team instruction, and hierarchy. The OT staff had more favourable perceptions of technical LRFs. We found three profiles for disciplines: (i) anaesthetists and intensivists had more favourable perceptions of technical LRFs than surgeons and nurses. (ii) Anaesthetists, anaesthesia nurse-technicians, and recovery nurses had a poorer perception of non-technical skills. (iii) Anaesthesia nurse-technicians and recovery nurses had less favourable perceptions of procedures, housekeeping, and situational awareness than anaesthetists and intensivists.

Conclusions. As healthcare focuses its safety efforts towards system issues rather than towards the individual provider of care, attention has turned to organizational factors, known as LRFs. Understanding how LRFs affect safety should enable us to design more effective measures that will improve overall safety. Strategies for improving patient safety should be tailored specifically for various clinical areas and disciplines.

Keywords: intensive care unit; operating theatre; patient safety; personnel

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Safety in hospitals and complex environments such as the operating theatre (OT) and the intensive care unit (ICU) rely on multiple system defences such as organizational structure, protocols, training received by professionals, and the quality of equipment or technology. Of particular interest are how medical errors occur, how they can be addressed within the healthcare system, and how the work environment affects medical errors and near misses. There is increasing acceptance of the idea that adverse outcomes are often due to system failures, whereby deficiencies at many different levels create the context in which human error can have a negative impact.1–3 Organizational factors that contribute errors and to safety can be grouped together into a limited number of general failure classes or latent risk factors (LRFs). LRFs are error-producing conditions such as poor design, maintenance failures, unworkable procedures, deficiencies in training, equipment design and use, and poor team coordination.4–6 Safety experts argue that proactively reducing such LRFs will result in the delivery of safer care more quickly than taking measures directed, often reactively, at specific providers of care.

Patient safety varies across institutions, within institutions, and between disciplines.5–9 One dimension along which it can vary is the clinical area, such as the OT or ICU. A proactive system approach to patient safety suggests that it is necessary to study all aspects of the system that comprises an operation or ICU hospitalization.10,11 Most studies focus on the impact of a limited set of factors, for instance, either...
Anaesthetists do not work independently from others and their performance is embedded in organizational factors. Different disciplines in the OT can have different work norms and the pace of their work can vary. Surgeons, anaesthetists, and critical care physicians seem more satisfied with physician–nurse collaboration than nurses. Nurses are less likely to agree that they were provided with adequate training to do the job than surgeons. Physicians’ views about the contribution of guidelines to safety and to clinical practice differs from those of nurses. Thus, it would be likely that interdisciplinary differences may exist in the perception of patient safety.

The aim of the present study was to test for differences in perceptions of LRFs and to explore the contribution of disciplines and clinical area (OT and ICU). Identification of differences between clinical area and disciplines allow measures aimed at LRFs that are below standard to be specifically tailored. Tailoring is necessary because correction of the various LRFs would require entirely different preventive actions. The advantage of identifying these differences is the ability to address these issues in a safety management programme.

Methods
Sample and procedure

The study was approved by the local Research Ethics Board. We chose to investigate the OT and ICU clinical areas. Both the OT and the ICU are dynamic environments where there is a wide variety of high-technology equipment, constant change, and time stress where there is a considerable risk of error. The study was performed at four OTs and two ICUs in four university hospitals in The Netherlands. We asked hospitals, where another safety programme was currently implemented, to participate in a safety programme. That is why two ICUs were incorporated in the study. Clinicians, trainees, and nursing staff were included in the study, if they had been in their job for more than 3 months. Disciplines included anaesthetists, anaesthesia nurse-technicians (anaesthesia N-Ts), recovery nurses, surgeons, theatre nurses, intensivists, intensive care nurses (IC nurses), and trainee anaesthesia nurse-technicians/theatre nurses (trainee A-T nurses).

Baseline characteristics

The following four patient characteristic variables were used as control variables: gender (1, male; 2, female), age (in years), working hours (contractual hours per week), and length of service in the job (1, <1 yr; 2, 1–5 yr; 3, 6–10 yr; 4, >10).

Survey instrument

The approach taken to assessing the state of individual LRFs is analogous to a health check, which measures a limited number of well-chosen diagnostic vital signs. Items, presented as statements, can be indicators of either potential problems or good practice.

In the current study, LRFs were measured using the Leiden Operating Theatre & Intensive Care Safety (LOTICS) scale, which has been validated with respect to factorial structure and reliability, and also its content and discriminative validity. It measures 12 LRFs with a total of 55 indicator questions: training, task-related communication, planning and coordination, design, maintenance, equipment resources, teamwork, team instruction, housekeeping, situational awareness, hierarchy, and procedures. Items, presented as statements, were indicators of either potential problems or good practice (Appendix). Respondents indicated the extent to which they agreed with each statement on a four-point scale (1, disagree completely; 4, agree completely). Higher scores indicated more favourable perceptions about working conditions.

Statistical analyses

The returned questionnaires were analysed using SPSS® version 17 (Chicago, IL, USA). For all LRFs, negatively formulated items were recoded so that a higher score always indicates more favourable perceptions of that LRF. Scale scores were generated by averaging the ratings of all items that were part of the scale. To calculate the percentage frequency of responses to each item, responses of agree completely and agree were combined, as were those of disagree completely and disagree.

The study sample was divided according to clinical area (OT or ICU) and according to disciplines. One-way analyses of variance (ANOVA) were used to compare the mean scores and baseline characteristics (age, working hours, and current years in the job). \( \chi^2 \) tests were used to compare the mean scores across discipline for gender.

To test for differences in perceptions of LRFs by clinical area and discipline, we used \( \chi^2 \). As there were differences in age, working hours, and length of service in the job, they were used as covariates. The Pearson correlation coefficients were calculated to examine the pattern of relationships between LRFs and clinical area and discipline.

Results

The overall response rate was 64% (768 out of 1260 questionnaires). The response rate ranged by hospital (62–65%), by clinical area (62–68%), and by discipline (62–69%). Respondents were predominantly female 71% with a mean age of 40.3 (F3,760=8.71, P<0.0001). Respondents had been in their job on average for more than 8 yr (mean 2.77, F3,760=2.97, P=0.019). Respondents worked on average 33.1 h a week (F3,760=8.97, P=0.000). Significant differences between disciplines were found in age, working hours, length of service in the job, and gender (Table 1).

Respondent characteristics and LRFs

We compared patient characteristic variables with LRFs. There was a significant difference for age with the design
of equipment \( (F_{3,760}=7.60, P=0.04) \). Younger staff had a somewhat more favourable perception of design. In the 18–25 age group, the mean was 3.09 (SD 0.36) compared with the age group > 55 mean of 2.95 (SD 0.41).

Staff with more working hours had more favourable perceptions of design \( (F_{3,761}=6.08, P \leq 0.001) \) and material resources \( (F_{3,761}=7.19, P \leq 0.001) \). Staff who had worked in the hospital for 5–10 yr had less favourable perception of communication \( (F_{3,761}=4.75, P=0.003) \).

### Clinical area: OT, ICU, and LRFs

Over 40–50% of the staff of the OT and ICU rated communication as poor. The ICU also rated equipment and housekeeping as poor (Table 2). Comparing OT and ICU, significant differences were found in training \( (F_{1,750}=8.96, P=0.003) \), communication \( (F_{1,749}=5.37, P=0.021) \), teamwork \( (F_{1,750}=6.33, P=0.012) \), team instruction \( (F_{1,750}=7.88, P=0.005) \), and hierarchy \( (F_{1,750}=1610, P<0.0001) \). The OT had more favourable perception of design \( (F_{1,750}=4.60, P=0.032) \) and equipment \( (F_{1,750}=22.0, P<0.0001) \).

### Discipline and LRFs

Anaesthetists, intensivists, and surgeons had more favourable perceptions of all LRFs, with the exception of anaesthetists for team instruction (49% of agreement) and communication (54% of agreement). Over 70% of the anaesthetists rated communication and housekeeping as poor (Table 3).

Significant differences on all LRFs were found for all disciplines. Surgeons and intensivists had more favourable perceptions than anaesthesia technicians and recovery nurses on instructions \( (F_{7,757}=7.93, P<0.0001) \), team instruction \( (F_{7,756}=11.0, P<0.0001) \), planning and organization \( (F_{7,756}=9.72, P<0.0001) \), teamwork \( (F_{7,757}=8.46, P<0.0001) \), and hierarchy \( (F_{7,756}=9.28, P=0.000) \).

Intensivists and surgeons had more favourable perceptions than IC nurses of equipment \( (F_{7,745}=10.04, P<0.0001) \), design \( (F_{7,756}=3.54, P=0.001) \), and maintenance of equipment \( (F_{7,756}=7.76, P<0.0001) \).

### Correlations

Bivariate correlations were calculated to examine the pattern of relationships between clinical area, disciplines, and LRFs. Correlations between clinical area and LRFs were significant for training, communication, design, equipment, team instruction and hierarchy (Table 4). The strongest association was found with training \( (0.107, P<0.01) \), hierarchy \( (0.133, P<0.01) \) and equipment \( (0.170, P<0.01) \).

For disciplines, significant correlations were found for all LRFs with exception of design. The strongest associations with disciplines were found for teamwork \( (0.298, P<0.01) \), housekeeping \( (0.210, P<0.01) \) and communication \( (0.209, P<0.01) \).
Discussion

We studied the influence of clinical area (OT or ICU) and discipline on reported scores in an inquiry on patient safety. We examined the clinical areas of OT and ICU because these are areas where adverse events frequently occur. We observed that ICU staff reported fewer problems for training, communication, team instruction, and hierarchy. This could be the result of the process, which is entirely different from OT or ward work. The OT had more favourable perceptions of design and equipment. Poor equipment places high demands on the performance of staff in demanding working environments. For instance, good design reduces the need for extensive training in the use of equipment, whereas poor design can be only partially compensated for by extensive training. One way to facilitate equipment resources is to minimize variation in equipment. An explanation could be that the OT is a more standardized environment than the ICU.

We found differences between disciplines in all LRFs, which sheds some light on differences between disciplines in their perception of patient safety. We speculate that this is the result of differences in work organization, content, and professional training. One might expect that the perceptions of physicians and nurses are different because of their different expertise and work responsibilities.

Three profiles between disciplines and LRFs were found. In the first profile, anaesthetists, anaesthesia nurse-technicians, and recovery nurses had lower perceptions of communication, team instruction, teamwork, planning and organization, and hierarchy (non-technical skills). Teamwork issues generally cluster around issues of miscommunication, lack of coordination, failures in monitoring, and lack of team familiarity. Communication and interaction between members of the anaesthesia team specifically have received less attention than communication in the OT during surgery. In the Netherlands, an anaesthesia team consists of an anaesthetist, frequently a trainee anaesthetist, and an anaesthesia technician. In general, it is a challenge within the OT to build functional teams. Usually, these teams are just co-incidentally formed, similar to airline crews. The teams consist of members of several different disciplines that work together for that particular operation or the whole operating day. This task-oriented team model with high levels of specialization has historically focused on technical expertise and performance of members with little emphasis on interpersonal behaviour and teamwork. In this model, communication is informally learned and developed with experience. This places a substantial demand on the non-clinical skills of the team members, especially in high-demand situations like crises.

In the second profile, we found that anaesthetists and intensivists had more favourable perceptions than surgeons of the technical LRFs (equipment, design, and maintenance). IC nurses had the lowest perception of these LRFs. A low rate of equipment problems was found during anaesthesia, indicating that their procedures for checking and maintenance of equipment were adequate. Human error and lack of familiarity with equipment have been shown to be more common than ‘true’ equipment failure. Anaesthetists and intensivists work more with equipment, design, and maintenance, which would explain why they perceived technical skills more favourably. The low perception of IC nurses has to do with performance obstacles related to misplacement of equipment related to inadequate workspace. Also current devices at the ICU bedside do not adequately support a nurse’s information-gathering activities. The performance obstacles related to misplacement of equipment can be eliminated by creating and reinforcing a protocol or by establishing a tracking system. The performance obstacle of inadequate workspace can require a major redesign of the physical layout of the ICU.

<table>
<thead>
<tr>
<th>LRFs</th>
<th>Anaesthetist</th>
<th>Anaesthesia N-Ts</th>
<th>Recovery nurses</th>
<th>Intensivists</th>
<th>IC nurses</th>
<th>Surgeons</th>
<th>Theatre nurses</th>
<th>Trainee A-T nurses</th>
</tr>
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<tbody>
<tr>
<td>Training</td>
<td>72</td>
<td>54</td>
<td>72</td>
<td>92</td>
<td>83</td>
<td>92</td>
<td>64</td>
<td>64</td>
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<tr>
<td>Communication</td>
<td>49</td>
<td>30</td>
<td>46</td>
<td>92</td>
<td>46</td>
<td>68</td>
<td>37</td>
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<tr>
<td>Planning and Co.</td>
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<td>67</td>
<td>81</td>
<td>67</td>
<td>96</td>
<td>80</td>
<td>70</td>
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<tr>
<td>Design</td>
<td>91</td>
<td>82</td>
<td>88</td>
<td>88</td>
<td>88</td>
<td>98</td>
<td>90</td>
<td>95</td>
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<tr>
<td>Equipment</td>
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<td>72</td>
<td>82</td>
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<tr>
<td>Maintenance</td>
<td>93</td>
<td>82</td>
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<tr>
<td>Housekeeping</td>
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<td>33</td>
<td>61</td>
<td>75</td>
<td>61</td>
<td>92</td>
<td>59</td>
<td>68</td>
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<tr>
<td>Teamwork</td>
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<td>92</td>
<td>87</td>
<td>98</td>
<td>95</td>
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<tr>
<td>Team instruction</td>
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<td>78</td>
<td>98</td>
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<tr>
<td>Sit. awareness</td>
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<td>71</td>
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<td>72</td>
<td>75</td>
<td>95</td>
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<tr>
<td>Hierarchy</td>
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<tr>
<td>Procedures</td>
<td>90</td>
<td>72</td>
<td>66</td>
<td>69</td>
<td>66</td>
<td>84</td>
<td>78</td>
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In the third profile, we found that nurses, especially anaesthesia nurse-technicians and recovery nurses, were more sensitive to procedures, housekeeping, and situation awareness. Physicians and nurses hold divergent views regarding adherence to rules and clinical guidelines.\textsuperscript{18–20} Nurses appear to hold more systematized and less individualistic conceptions of clinical work than physicians and appear to be more fastidious in adhering to documented procedures.\textsuperscript{17} Anaesthesia nurse-technicians often serve as controllers for the anaesthesia team by getting supplies and equipment ready for the anaesthetic procedure. That they are confronted with non-availability of equipment explains why they perceived housekeeping as poor.

The attitudes of healthcare disciplines towards working conditions are a component of an organisation’s safety culture. An important and perhaps glaring gap in our knowledge of cultural assessment of safety relates to the sources of variation in safety culture. We do not understand whether the variation in culture is explained by the clinical area or staff.

We found a correlation between clinical areas, disciplines and hierarchy. Hierarchy is more prevalent in high-intensity areas such as the OT, ICU, and emergency department.\textsuperscript{31} It affects the feeling of freedom to speak up, which might explain why hierarchy plays a role at the clinical level and between disciplines. This might explain why hierarchy plays a role at the clinical level and between disciplines.

Within hospitals, technology use is steadily increasing. In our study, we found a correlation between the quality and availability of equipment and the clinical area. While technology has the potential to improve care, it is not without risks. It can cause significant harm if not adequately designed, regulated, and maintained. Technology has been described as both part of the problem and part of the solution for safer healthcare. Organization of workflow around equipment and process is vital. Given our findings, it would be advisable that hospital procurement services apply risk
assessment and risk management analysis before decisions involving new equipment in order to tailor measures to be taken for individual groups to minimize the risks of latent errors. Correlations with disciplines and LRFs were found on non-technical skills (Fig. 2). Our study supports the current view as to why much attention is paid to non-technical skills training.\textsuperscript{32, 33}

Division of labour among multiple professions can provoke different views on safety. In our study, we not only found differences between physicians and nurses but also differences within clinician and nursing specialties. Compared with other disciplines, the anaesthesia team also feels the safety deficiencies in the organizational infrastructure more acutely. The different tasks performed by the various disciplines could explain why they see only a certain aspect but not the whole picture (Fig. 3). We therefore recommend that in the context of safety programmes, all disciplines should be involved, not just single disciplines. Identification of differences between disciplines would allow measures to be tailored. Identification of separate underperforming latent factors is warranted, because their correction requires entirely different preventive actions.

The results of this study led to specific interventions on the OT and ICU. Anaesthetists, anaesthesia nurse-technicians, and recovery nurses had significantly different results in communication and team instructions. Interviews with staff revealed that the results in these LRFs were based on a lack of information causing ambiguity in responsibility. One OT started with an intervention based on the introduction of a standardized handover protocol through the perioperative process and another OT started an intervention to promote the availability of procedures. The ICU had less favourable perception of equipment and design. Interviews with staff revealed that this was based on the different prototypes of equipment. Therefore, one ICU started an intervention to standardize equipment and supplies for all equipment and development of manuals with a uniform design.

There are limitations to our study. All data were cross-sectional; however, a sampling bias remains possible, and some caution must be exercised in generalizing our study findings. Nurses comprise 79% of the study population, as they are the bulk of ICU and OT staff. Thus, it is likely that nurses’ perceptions of LRFs contribute most. Moreover, we have attributed differences in LRFs by disciplines, when they could also be explained by gender, age, or length of service. That was the reason for including the patient characteristic

Fig 2 Overview of the significant correlations presented by clinical area, discipline, and LRFs.

Fig 3 Perspective of different disciplines on LRFs.
data as covariates in the analyses. Another point of concern is that the sample only included staff working in university hospitals in the Netherlands. The experience of participants in these hospitals might differ from those in other hospitals or indeed in other countries. Future research needs to test the hypotheses across a wider sample, including peripheral hospitals, to see if the present findings can be confirmed.

As healthcare has focused its safety efforts towards the system rather than towards the individual provider of care, organizational factors have emerged, known as LRFs. Understanding how LRFs affect safety should enable us to design more effective control measures that will impact the overall safety condition. We would argue that systematic analyses and step-by-step improvements are feasible and can directly impact the culture. Strategies for improving patient safety should be tailored specifically for clinical areas and disciplines.

**Declaration of interest**

None declared.

**Appendix: LOTICS scale**

<table>
<thead>
<tr>
<th>Training</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate coaching of new personnel Keeping employees informed about new medical/technological developments Training employees in the operation of new equipment Adequate supervision of trainees in their practical period Co-workers on my department have the necessary qualifications In OR combination of staff junior/junior are avoided // on the ICU an adequate mix of seniority is applied</td>
<td>Following new technologies when procuring new equipment Availability of materials and equipment at the time it is needed Insufficient quality of materials and equipment Worn-out or faulty equipment replaced in a timely way Equipment frequently repaired Instruments often incomplete</td>
</tr>
<tr>
<td>Communication</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Information about changes in OR programme/planned procedure timely provided Information about changes in OR programme/planned procedure are communicated through the right channels Adequate communication about patients with other disciplines Information to perform procedure available at the time when it is needed Adequate communication about patients between teams Information to perform procedure not properly communicated</td>
<td>Maintenance carried out on a regular basis Maintenance inspection performed timely OR/ICU equipment badly maintained Maintenance schedule is lagging</td>
</tr>
<tr>
<td>Planning and coordination</td>
<td>Teamwork</td>
</tr>
<tr>
<td>Organizational changes not adequately supported within the department Lack of advance planning within the department Sufficiency of planning</td>
<td>I really feel I am a part of my team Team’s ability to deal with unexpected events Members of my team work together as a well coordinated team Clear view of who is doing what and when</td>
</tr>
<tr>
<td>Design</td>
<td>Team instructions</td>
</tr>
<tr>
<td>Equipment operation is difficult Controls or displays are hard to read Controls of displays are unclear and/or lacking Too much information on controls or display</td>
<td>Team members debriefed on what they can expect during operation/shift Team members sufficiently instructed during operation/shift I have confidence in my other team members</td>
</tr>
<tr>
<td>Situation awareness</td>
<td>Hierarchy</td>
</tr>
<tr>
<td>Team members alert each other to problems Members of my team know what one another is doing Members of my team monitor each other’s performance Adequate exchange of information during the operation/shift</td>
<td>In my department, we listen to each other’s opinion In my department, you can freely say that you do not agree In my department, people are open for criticism that concerns work In my department, employees do not always dare to ask for explanations In my department, it gets you charged if you are raising something that is not good</td>
</tr>
<tr>
<td>Housekeeping</td>
<td>Procedures</td>
</tr>
<tr>
<td>Materials are often stored haphazardly The working environment is always clean An optimal arrangement of equipment is often not possible</td>
<td>Accessibility of procedures/regulations/rules Violations of procedures/regulations/rules Procedures/regulations/rules frequently not clear Procedures/regulations/rules frequently not applicable in practice Procedures/regulations/rules applied correctly Procedures taken a bit less seriously to do a better job</td>
</tr>
</tbody>
</table>
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