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Sustained decrease in latent safety threats through regular interprofessional in situ simulation training of neonatal emergencies

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ABSTRACT

Simulation training at trainees' actual workplace offers benefits over traditional simulation-based team training. We prospectively investigated whether regular in situ simulation training of neonatal emergencies in an interprofessional and interdisciplinary team could be used to identify and rectify latent safety threats (LSTs).

For this purpose, we conducted 1-day in situ simulation trainings at the Department of Gynaecology and Obstetrics, Feldbach, Austria, targeting anaesthesiologists, obstetricians, midwives, nurses and consultant paediatricians. Using published criteria for categorising LSTs, we collected LSTs, either recognised by trainers or training participants, categorised them qualitatively (*medication*, *equipment*, *resource/system*) and based on their potential for harm, discussed them with training participants, and reported them to hospital leadership.

We conducted 13 trainings between June 2015 and April 2023, identifying 67 LSTs, most in the category of *equipment* (42/67, 62.7%), followed by *resource/system* (14/67, 20.9%) and *medication* (11/67, 16.4%). Sixty-one (91.0%) of the LSTs could be rectified by the next training. We observed a significant negative correlation between the number of delivered trainings and the frequency of identified LSTs (Pearson correlation coefficient r= –0,684, p=0.01).

While we identified a higher number of LSTs in comparison to previously published studies, regular in situ simulation training of neonatal emergencies over a period of almost 8 years positively impacted patient safety, as the majority of LSTs was rectified by the next training. Even more important, the decrease in LSTs with the increasing number of delivered in situ simulation trainings underlines the sustained effect of this educational intervention.

INTRODUCTION

By addressing healthcare professionals and teams at their genuine professional workplace, in situ simulation training (ISST) offers improved immersion while enabling unbiased analysis of teamwork functions and the healthcare environment.[1 2] ISST has been successfully established in many healthcare settings targeting different disciplines and professions, including medical and surgical inpatient units, emergency medicine, trauma care, paediatric emergency medicine, perinatology and neonatal intensive care.[3] Despite limited high-quality studies, ISST has a positive impact on learning and organisational performance as well as the potential to improve patient outcome.[3 4]

Despite the growing body of evidence, studies of neonatal ISST are still scarce. Of the existing reports and investigations, the majority focus on outcomes in the simulation laboratory[5 6] or on the testing of new facilities.[2 7 8] Only few studies have reported patient-related outcomes, such as an association between regular ISST at a level IV neonatal intensive care unit (NICU) and a reduction in code blue events.[9] Bhatia *et al*[10] described a decrease in mortality as well as less need for life-saving interventions after birth following the introduction of an interprofessional in situ neonatal resuscitation training programme.

As identification and rectification of latent safety threats (LSTs) can help improving patient safety, we prospectively investigated whether LSTs could actually be identified and rectified through regular ISST of neonatal emergencies in an interprofessional and interdisciplinary team over a period of 95 months.

METHODS

Neonatal care at the Department of Gynaecology and Obstetrics, Feldbach (2021: 1052 born infants), Austria, is being provided by practicing consultants for paediatrics and adolescent medicine. However, those paediatricians are not available on a 24/7 basis and, therefore, anaesthesiologists, obstetricians, midwives and nurses often are the first ones being confronted with sick neonates or

neonatal emergencies. Hence, the trainer team of the Paediatric Simulation Group Graz (PaeSiGG), which is coordinating and delivering all simulation-based educational activities at the Division of Neonatology Graz (regional NICU level IV), has been providing regular 1-day ISST for these target groups since 2015.[11] All trainers are neonatologists and paediatric intensive care specialists with additional training in paediatric simulation, performance debriefing and crisis resource management. Trainings include 45 min of theoretical instruction and 6×45 min of simulated practice in three groups of six persons each: technical skill training (3×45 min) focuses on airway management, high-quality mask ventilation, vascular access, emergency drugs and the cardiopulmonary resuscitation algorithm, while further 3×45 min are dedicated to scenario-based high-fidelity team training with consecutive, structured debriefing.[12] Scenario contents reflect typical emergency situations that occur in regional hospitals including perinatal asphyxia, meconium aspiration syndrome, unexpected preterm birth, sepsis, neonatal seizure and neonates with cardiac malformations. All anaesthesiologists, obstetricians, midwives and paediatric nurses at the State Hospital Feldbach regularly participate in the ISST, with the goal of participation at least every 2 years. Newly employed healthcare professionals are prioritised and invited to attend ISST at the earliest possible time.

Evaluation

Our primary outcome measure was the number and type of LSTs, using the definition by Patterson *et al*[13]: '*system-based threats to patient safety that can materialise at any time and are previously unrecognised by healthcare providers, unit directors or hospital administration*'. LSTs, either recognised by trainers or training participants during simulation trainings or debriefings, were collected, categorised qualitatively (*medication*, *equipment*, *resource/system*[13]), immediately discussed with training participants and reported to hospital leadership. As secondary outcome measure, we categorised LSTs based on their potential for harm, as defined by Dadiz *et al*[2]:

minor (LSTs of low probability of causing harm to patients, families or staff),

major (LSTs with potential to cause harm if linked with other LSTs),

serious (LSTs likely to result in harm if not resolved).

RESULTS

Between June 2015 and April 2023, 13 trainings with a median number of 17 participants (range 14–19) were delivered. We identified a total of 67 LSTs during the 13 trainings (median of 4 per training, range 2–13), most in the category of *equipment* (42/67, 62.7%), followed by *resource/system* (14/67, 20.9%) and *medication* (11/67, 16.4%; figure 1). Sixty-one (91.0%) of the 67 LSTs could be rectified by the next training. There was a steady decline in the number of LSTs over the study period (June 2015 (i.e., 1st training): n=12; April 2023 (i.e., 13th training): n=2; figure 2) with a significant negative correlation between the number of delivered trainings and the frequency of identified LSTs (Pearson correlation coefficient r=–0,684, p=0.01).

Of the 67 LSTs, 3 (4.5%) were categorised as serious, 19 (28.3%) as major and 45 (67.2%) as minor. Of the three serious LSTs, two were related to *equipment* and one to *medication*. All three serious LSTs were detected during the first five trainings and all could be quickly resolved.

DISCUSSION

So far, only a few studies have reported identification of LSTs through neonatal and/or paediatric ISST. Yajamanyam and Sohi[14] found seven LSTs during 21 in situ trainings in the paediatric emergency department and neonatal unit, four being related to equipment and medications. Zimmermann *et al*[15] implemented a team-oriented in situ resuscitation training programme in their

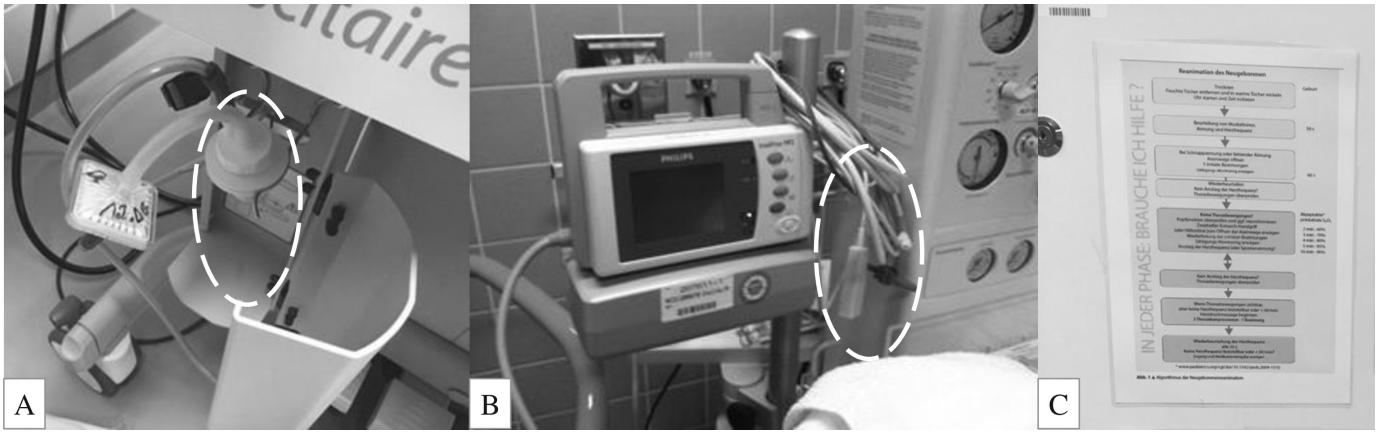

Figure 1 Examples of identified latent safety threats: (A) Too small suction container at the resuscitation table, (B) ECG electrodes not connected to patient monitor at the resuscitation table and patient monitor not activated for immediate use, (C) outdated neonatal resuscitation algorithm from 2010 mounted in the neonatal resuscitation suite.

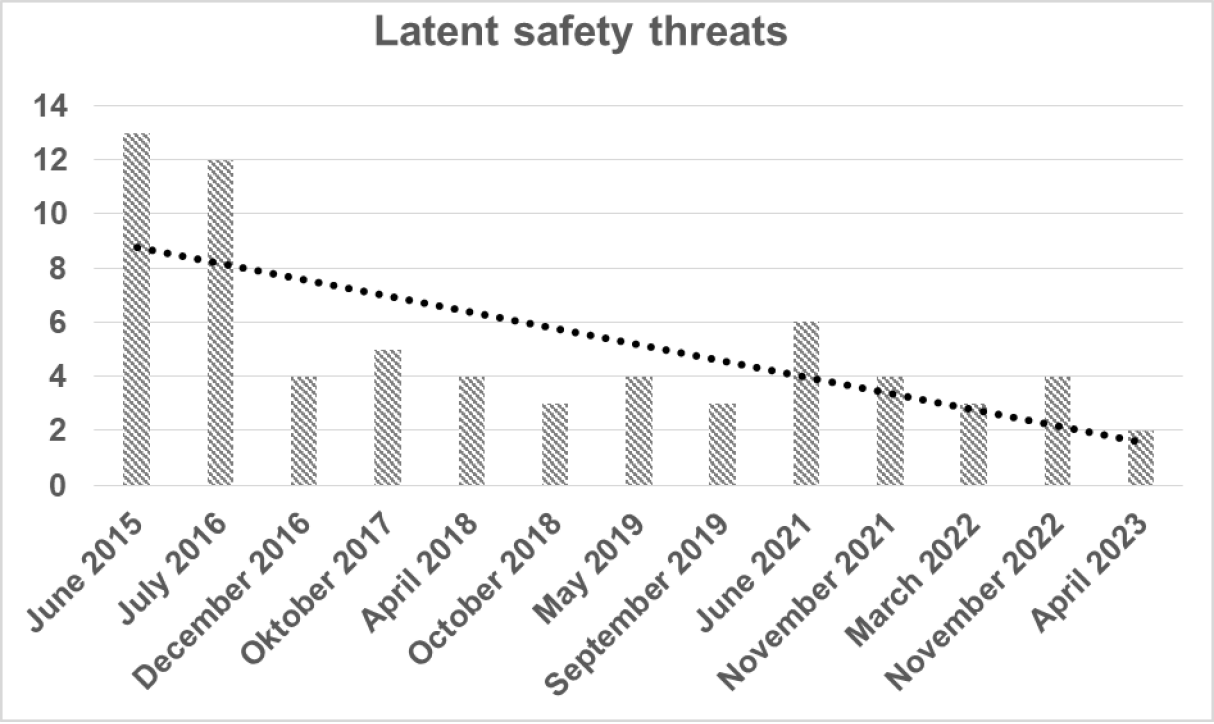

Figure 2 Number of identified latent safety threats (y-axis) for each individual in situ simulation training.

tertiary paediatric hospital and detected 23 different LSTs during 20 simulation sessions. During the delivery of 15 in situ trainings at their level III NICU, Eckels *et al*[1] identified four LSTs and used them to improve system-based processes. Interestingly, we identified considerably more LSTs per training than described by previous studies. Different definitions of LSTs and variances in methods of counting and summarising most certainly contributed to this finding, but it must be kept in mind that we trained and surveyed a regional hospital without paediatric department, which may explain the relatively high rate of equipment issues that we detected. Another contributing factor could be that the external trainers from the paediatric reference centre were able to identify more LSTs than local professionals, as they are not as susceptible to system blindness.[16]

To our knowledge, we are first to report a negative correlation between the number of delivered ISSTs of neonatal emergencies and identified LSTs. This emphasises the lasting positive effect of our educational intervention on local patient safety. In this context, the temporary increase in LSTs in June 2021 is remarkable—during the COVID-19 pandemic, which hit Austria in March of 2020, many simulation-based team trainings were cancelled due to required social distancing and concerns about their safety.[17] Unfortunately, these circumstances also affected our training programme, resulting in an undesired 22-month interval between two trainings. The temporary increase in LSTs, which we observed after resumption of our training activities, underlines the need for continuous simulation-based in situ team training in a high-acuity setting such as any delivery room.

One limitation of our study is that we did not assess the potential direct impact of ISST on clinical practice and the management of neonatal emergencies. This could be achieved either by observation and subsequent analysis of clinical performance[18] or by comparing relevant patient-related parameters such as Apgar scores[19] or the need for certain resuscitative measures[20] between different time periods.

CONCLUSIONS

Through regular interprofessional and interdisciplinary ISST of neonatal emergencies over a period of almost 8 years, we positively impacted patient safety by identifying LSTs and rectifying most of them by the next training. The decrease in LSTs with the increasing number of delivered ISSTs emphasises the sustained effect of this educational, team-oriented intervention designed for a vulnerable patient cohort.

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