

**Many critical incidents could be avoided by preanaesthesia equipment checks:  
Lessons for high reliability organisations**

**Short report**

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Many critical incidents could be avoided by preanaesthesia equipment checks:

Lessons for high reliability organisations

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## **Many critical incidents could be avoided by preanaesthesia equipment checks: Lessons for high reliability organisations**

Recent studies from France<sup>1</sup> and United Kingdom<sup>2</sup> on device-related adverse events show that the use of medical technology plays an important role for safe anaesthesia in hospitals. As Germany does not have a national database for adverse events, learning from medical device-related incidents is generally limited to an intra-hospital level and often based on only a few voluntary incident reports.<sup>3</sup> Thus, the dissemination of knowledge on device-specific risk situations is slowed down and opportunities for inter-organisational learning to enhance patient and staff safety are reduced.

With an exemplary focus on anaesthetic machines and ventilators, we screened and analysed anaesthesia device-related voluntary incident reports gleaned in 2010 from three co-operating hospitals of the German state of North-Rhine Westphalia as well as from the website of the German Patient Safety Optimizing System (PaSOS).

The analysis of reports was performed by an interdisciplinary team (anaesthesiologist, head of medical technology, economist specialized in incident reporting) and based on descriptions in title and free text of the report form as well as relevant data on severity, frequency, place and time of the incidents. Reports were classified as equipment failure or user-or-application error, the latter further sub-classified into different types of unsafe acts as defined by *Reason*.<sup>4</sup> We also wanted to find out whether incidents could have been avoided by a pre-anaesthetic equipment check and at what stage of device usage they were first detected by staff. Finally, reported types of anaesthetic equipment were categorized and similar and frequently mentioned risks recorded.

A total of 151 critical incident reports were analysed. Of these, 104 (69%) resulted from user-or-application errors, 36 (24%) from equipment faults and 11 (7%) could not be classified because of insufficient information. Of the non-equipment errors, 69 (66%) were classified as violations and 35 (34%) as errors. In the violations category, routine violations of device testing procedures were most frequent. 92 incidents (61%) were originally caused during preparation of equipment, 46 (30%) while connecting or using the equipment, 6 (4%) during post-processing and 7 (5%) could not be classified. In contrast, 129 incidents (85%) were first detected while connecting or using the equipment. Of these, 67 (52%) could have been prevented during preparation by a properly conducted pre-use check of anaesthetic equipment used.

Table 1 lists the ten most frequently occurring risk situations and equipment faults, all together making up 52% of the overall reported critical incidents. 63 incidents (42%) involved only the anaesthetic machine while the remainder (58%) involved at least one additional component, reflecting the special risks of a highly complex work and equipment environment. According to staff involved, the severity of patient harm could have been “serious” in 43 incidents (28%) and “very serious/fatal” in 44 (29%). By contrast, frequency was reported for 66 incidents (44%) as being “seldom/rare” and for 34 (22%) as being “singular/very rare”. Filtering of reports, however, revealed that this individual low rating could also be found in some of the frequently occurring risk situations reported in different healthcare facilities.

In summary, the reports analysed were primarily caused by organisational and managerial conditions influencing human performance rather than lacking or misapplied expert knowledge. Results indicate, however, that regular pre-use checks to ensure completeness and correct functioning of equipment might have identified and avoided many of the voluntarily reported critical incidents. Thus, our results are in agreement with previous studies that routine violations of this principle in practice<sup>5</sup> – without the intention of committing unsafe acts – constitute an important factor for patient safety in anaesthesia. To avoid a “normalization of deviance”, a safety culture is required that neither tolerates such behaviour nor necessitates it, e.g. due to undue time pressure.<sup>6</sup> It is the hospital management’s responsibility to create the required conditions. An established safety culture, optimal structures/procedures, training/practice in routine procedures/simulations, and organisational learning are essential principles and strategies for healthcare organisations to address safety aspects and routines.<sup>6</sup>

Our results give a first impression of the causes of frequently reported critical incidents related to anaesthetic machines and ventilators. It may improve safety to sensitize staff to single serious or most frequent risk situations and equipment faults in medical-device user instructions. Hospitals can additionally strengthen their internal risk management strategies<sup>7</sup> by considering inter-organisational risk knowledge on equipment-related critical incidents for procurement planning or anaesthesia training.

Finally, a number of limitations must be kept in mind. Voluntary incident reports under consideration constitute only a fraction of device-related incidents occurring in about 10 million anaesthetic procedures in German hospitals per year. Hence further studies pooling more anaesthesia device-related reports from different healthcare facilities are needed to identify tailored measures for hospitals as high reliability organisation. Other limitations refer to the database of incident reporting which is limited due to lack of time, feedback and legal concerns, or to reported data that reflect the reporting person’s subjective (as desired for voluntary incident reporting) and therefore incomplete assessment and perception. Furthermore, the quality of reported data is limited in some cases. This is mainly due to incomplete report forms and varying degrees of information in title and free text, which do not always give a clear picture of the event sequence. Our available results, therefore, do not permit a quantitative assessment but do provide a first description of the type and causes of reported incidents related to anaesthetic equipment in German hospitals.

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**Conflicts of interest**

The authors declare that they have no conflict of interest.

**Presentation**

Selected results were presented at the 12<sup>th</sup> German congress on health services research in Berlin, Germany.

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**Table 1:** Frequently occurring causes of voluntary reported critical incidents related to anaesthetic machines and ventilators (n=151).

Description	No. of incidents n (%)
Unlocked anaesthetic vaporizer	14 (9)
Problems associated with replacing sodalime canisters	13 (9)
Blocked sampling line	11 (7)
Lung ventilation using ventilator settings from the previous patient	8 (5)
Alternative manual means of lung ventilation unavailable	7 (5)
Oxygen flow turned off during pre-oxygenation	6 (4)
Empty air cylinder used as a ventilator driver	6 (4)
Electrical supply to anaesthetic stations switched off during anaesthesia	5 (3)
Anaesthetic machine not fully functional on first connection to the patient	5 (3)
Leakage from anaesthetic equipment and system	4 (3)
Total (%)	79 (52)

*Sources: Co-operating hospitals, PaSOS*