

PREVENTING RISKS WHILE WORKING WITH MEDICAL TECHNOLOGY AS PART OF NURSING CARE

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Abstract

Introduction: One of the important risk management domains is working with medical technology as part of nursing care.

Materials and methods: The aim of the research was to assess nurses' opinions on working with medical technology and to learn about their knowledge of manipulation with oxygen. To learn about nurses' opinions, a quantitative method and the technique of moderated interviews were used. The sample research group consisted of 772 nurses working in Czech hospitals. The sample group of nurses was representative from the point of view of Czech regions.

Results: Most nurses (61.5%) believe that every employee working with medical technology must be educated by a competent firm or a qualified biomedical engineer. Fewer nurses (35.2%) think that education led by any head nurse is enough. 2.9% of nurses did not know the answer to this question. The nurses' knowledge of the main safety risks of the manipulation with oxygen was also studied. Most nurses (70.7%) think that the main risk lies in explosions when higher fatty acids come into contact with oxygen. Fewer nurses (17.4%) see the main risk in increasing the incendiary temperature because pure oxygen causes the increase of incendiary temperature of all inflammable substances. 9.0% of nurses answered: "I do not know".

Conclusion: The way to prevent errors lies in educating staffs, establishing clear safety protocols and strict check-ups to ensure they are followed. Assessing the general knowledge of employees who work with medical technology and their knowledge of the main safety risks of manipulation with oxygen should be one of the systematically measured and assessed risk indicators. Increasing patients' safety in providing nursing care brings positive results.

Key words: *safety; nursing care; medical technology; medical gas; adverse events*

INTRODUCTION

Systems of quality and safety share common values. The safety of patients is acknowledged as an important part of an effective health care system. Systems dealing with accident reports and errors (adverse events) are the basic part of any

system dealing with quality and safety. Efficiency is ensured mainly by the identification of risk domains or factors and establishing risk indicators, which help them to be followed and assessed. That enables the identification of repeated problems, which may have a negative influence on the safety of the provided

nursing care, and establish prevention measures in time and keep their efficiency under control.

Adverse events (such as non-alertness, errors or rule breaking) have different causes and appear on different levels. An important prerequisite for their decrease is the successful establishment of risk management, primarily the establishment of monitoring adverse events and factors related to complete or incomplete errors.

Instrument techniques, often used as a means to a higher level of safety of the nursing care provided, bring, among others, negative consequences as well. How to work with modern instruments is determined by Act no. 268/2014 Coll., on medical technology. It determines prevention from adverse events when using medical technology and establishes measures on how to proceed in the case of adverse events. The purpose of this Act is to ensure the provision of health care using convenient, safe and effective medical technology, so that people's health is not impaired.

Act no. 378/2007 Coll., on medical drugs and regulation no. 84/2008 Coll., on medicines should be applied to medical gases including oxygen.

It is clear that instrument malfunction and human errors may occur and that errors cannot be prevented. Insufficient check-ups and instrument maintenance support failures and malfunctions in medical technology and manipulation with medical gases. The other factors are unprofessional interventions in these systems, their use by inadequately educated staff, overload, and their use for different purposes etc.

MATERIALS AND METHODS

The method of moderated interviews was used to learn about the nurses' opinions. The field research was carried out using the method of a moderated interview between the interviewer and a respondent. The data was collected through INRES inquiry net. The research included 216 interviewees from throughout the Czech Republic. The interviewees were trained before the initiation of the research. The statistical analysis program SASD 1.4.10 was used for data processing. The first stage

of the classification and the contingency table of the second stage of the classification were processed. The level of dependence between the chosen variables was based on the Chi-Squared Test and other test criteria. The significance level was set to the value of 5%.

The selected sample group included 772 nurses who work in shifts on ward blocks in hospitals in the Czech Republic. The basic representative factor for building the sample group was the number of nurses in Czech regions. The regions were defined on the basis of the administrative division from the 1st January, 2001. During the research, which was carried out in the second half of 2013, nurses from all Czech regions were addressed. The deviation from the basic sample group in the division by regions did not exceed 0.3%. This is why the conclusions of the research are valid for the nurses in the regions of the Czech Republic.

RESULTS

One of the domains concerning nursing safety was aimed at the safe manipulation with medical technology. The knowledge of the requirements on the employees who work with medical technology and their knowledge of the main safety risks in the manipulation with oxygen were tested.

Most nurses (61.5%) believe that all employees working with medical technology must be educated by a competent firm or a qualified biomedical engineer. Fewer nurses (35.2%) think that education led by any head nurse is enough. 2.9% of nurses did not know the answer to this question (Chart 1).

There were no statistically significant connections between this indicator and the monitored socio-demographic indicators. The division of the sample group of respondents applies to the whole and its individual parts too, which were divided according to the monitored socio-demographic indicators.

The next monitored indicator was the nurses' knowledge of the main safety risks of the manipulation with oxygen. The question was: Is the main safety risk of the manipulation with oxygen: 1. higher incendiary temperature – pure oxygen causes the increase of the incendiary temperature of inflammable substances; 2. explosion –

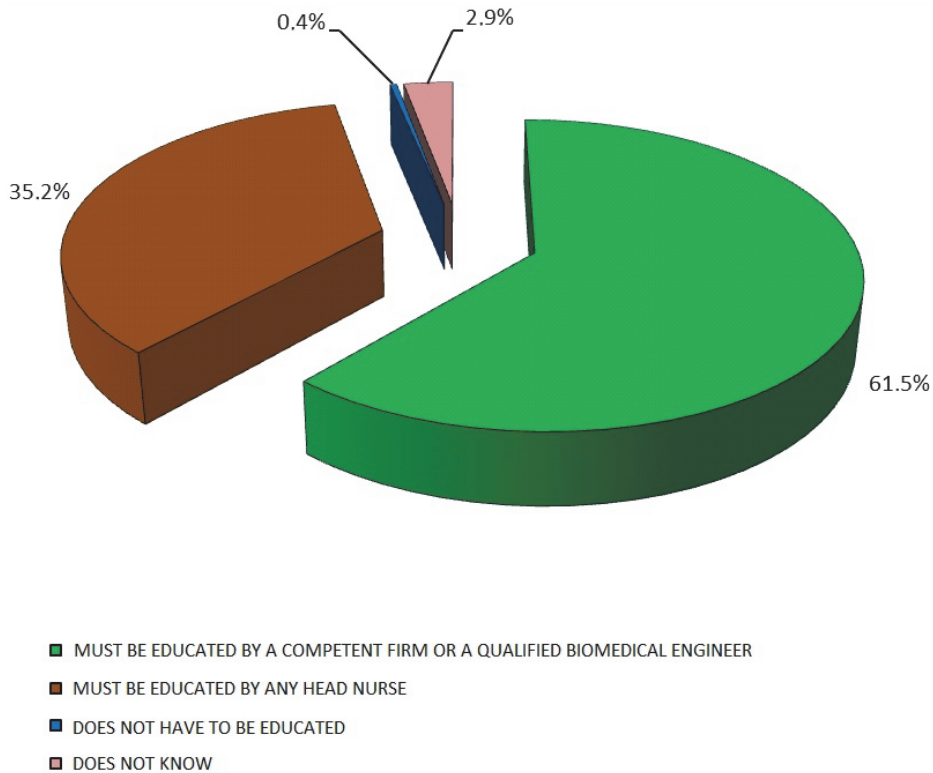


Chart 1 – Employees’ preparation for the manipulation with medical technology $N = 770$

higher fatty acids are an excellent fuel in oxygen, and when they come into contact with oxygen they are combustible and explode; 3. the emergence of pressure blow during slow opening; 4. I do not know.

Most nurses (70.7%) chose the right answer because they believed that the main risk is an explosion due to the contact of higher fatty acids with oxygen, which causes combustion and explosion. Fewer nurses (17.4%) saw the main risk as the increase of incendiary temperature due to the increase of the incendiary temperature of all combustible substances when it comes into contact with pure oxygen. 9.0% of nurses answered “I do not know” (Chart 2).

The analyses carried out in the second classification stage did not show any significant differences in the nurses’ responses, which were divided according to the monitored socio-demographic indicators.

DISCUSSION

If a patient is at least partially harmed due to the medical information technology or medical technology use, it concerns iatrogenic technological harming. Inexperienced staff may often be the cause of a false feeling of safety during their use (Weiner et al. 2007). Our research shows that most nurses (61.5%) believe that every employee working with medical technology must be educated by a competent firm or a qualified biomedical engineer. It is worth noting that 2.9% of nurses do not know how an employee working with medical technology should be prepared.

The results of several qualitative studies aimed at the analysis of reported adverse events related to medical technology show a direct connection to constructional errors (Wiklund 2013, Flewwelling et al. 2014).

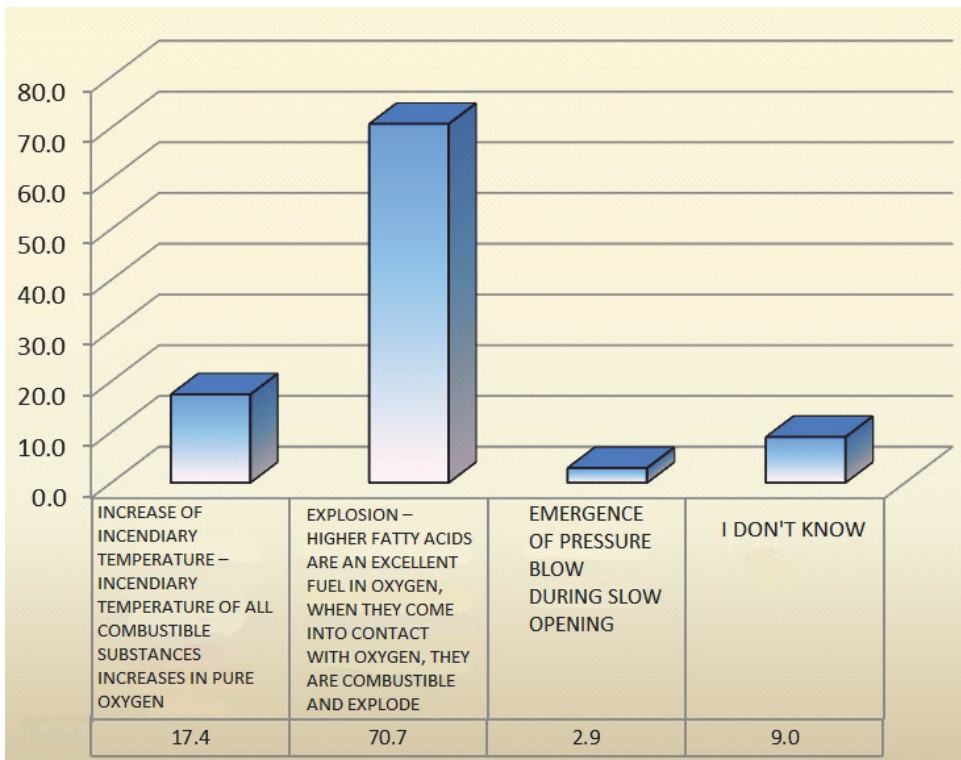


Chart 2 – Main safety risks when handling oxygen N = 764

Flewelling et al. (2014) state that the education should be led by a competent person who is able to adequately react to user requirements and discover wrong instrument construction, which often causes potential errors.

Mehraban et al. (2013), for example, deal with the education of medical technology users. The results of the qualitative study, which was aimed at the way nurses explain and see the problems regarding the education of new technology users, showed that education before and during medical technology use is very important. The research of the factors influencing the successfulness of establishing new technologies showed that only half of the nursing staff saw the process as good, or even as very good.

The most frequently mentioned factors preventing medical technology from real use are connected to its type, its functionality, ease of use, function and risk for patients (de Veer et al. 2011).

One of the most significant organizations dealing with the issue of dangers caused by medical technology is the Emergency Care Research Institute (ECRI). Based on the reports of adverse events, the Institute annually issues a list of the 10 most frequent dangers regarding medical technology. In the “Top 10 Hospital C-Suite Watch List for 2016” it is stated that, among others, the insufficient education of staffs regarding technology use in operating theatres is very frequent and risky. According to the ECRI estimates, staffs that use new technology in operating theatres with no or insufficient education can cause up to 70% of accidents (Top 10 Hospital C-Suite... 2016).

The Czech Republic is involved in the European system of the vigilance of medical technology, which should enable a direct, timely and harmonized implementation of field safety corrective action (FSCA) in all member states where the technology is used. FSCA are measures accepted by producers

with the aim of decreasing the death risk or a severe worsening of health condition caused by the use of medical technology. The measures comprise drawing medical technology from the market or additional information on how to use it. The producer informs on the field safety corrective action through field safety notice (FSN).

Medical gases have been included in medicines due to the numerous risks regarding their administration. FDA (U.S. Food and Drug Administration) issued public health recommendations regarding death prevention and patient injury due to the wrong administration of medical gases. The recommendations work on the presumption that, in most cases, patients were administered different/wrong gases instead of oxygen. The Administration also describes repeated errors due to the insufficient education of staffs, who did not properly study the notices on gas tanks during the gas system installation (Preventing Surgical Fires... 2011). 70.7% of the nurses in our research believe that the main risk lies in explosions because higher fatty acids burn and explode when they come into contact with oxygen, which corresponds to the regulations of the Czech Association of Industrial Gases (Dvořáková et al. 2006).

The content of the education of the staffs who manipulate medical gases is established. In particular or includes warnings about the safety risks and the knowledge of markings, including all of the symbols on the labels (Guidance for Hospitals... 2001).

The FDA has received four reports of confusing medical gases, which caused 7 deaths and 15 severe injuries. In all cases, the patients were supposed to receive medical oxygen but the error of wrong tube connection occurred (Guidance for Hospitals... 2001).

A bottle of oxygen exploded while a patient was being prepared for transport to another intensive care unit. The received information did not make it possible to exactly identify the cause because all of the evidence was destroyed in the fire. Situations such as this one lead to new recommendations and educational changes which should be aimed at realizing the possible risks (Kelly et al. 2013).

The Czech Association of Industrial Gases regularly releases an overview of the events regarding industrial and medical gases.

Considering that oxygen and other medical gas use are expanding, we should, for example, pay attention to:

- administrating the correct concentration for nebulization;
- safe administration of analgesic gas compounds in obstetrics, stomatology or surgery during short operations, e.g. in repositioning fractures, colonoscopies, catheter extractions, intravenous cannulation etc.;
- the education of patients for home oxygen therapy.

The above-mentioned is co-ordinated by the State Institute for Drug Control (SÚKL), which also administers the Register of Medical Products.

The group of experts dealing with patient safety established by the WHO issued regulations to decrease the risks. They believe that increasing the safety of technological services will contribute to a non-repressive and open reporting on adverse events, and also to accreditations or certifications and processing instructions for use. These come from a study of the human factors, which is important for decreasing potential risks. The combination of the solution methods decreases the risks regarding medical technology (Newton et al. 2010).

CONCLUSION

The safe manipulation of medical technology and the safety risks of the manipulation with medical gases are closely related. Although adverse events reports are not frequent, it is necessary that medical staffs are regularly educated at all levels and that the management does not tolerate violations of duties, safety protocols and regulations. The consequences of errors may be tragic for patients, as well as for staffs. Scientific technological development always brings new risks that result from modern technology use and they should be accounted for. Planned, systematically measured and evaluated risk indicators bring positive results regarding patient safety in nursing. Nevertheless, it is most important for organizations to acknowledge errors and wrong procedures and to show sympathy to patients and their families. They should not

impute blame on individual staff members but view errors as a useful experience.

CONFLICT OF INTEREST

The authors have no conflict of interest to disclose.

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