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THE RISK ASSESSMENT OF ADVERSE EVENTS OF NURSING ACTIVITIES AS THE ELEMENT OF QUALITY MANAGEMENT IN HEALHCARE

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Abstract
The purpose of the paper is to present MedCARVER+Shock method and Pareto analysis and its usability for the risk assessment of adverse events of nursing activities. 888 activities carried out by all 190 nurses working at the District Hospital X located in Poland were taken into account. During the research the qualitative approach was used. As the result sixteen groups of nursing activities causing the highest risk of adverse events were selected. Special attention required in: admission of a patient to the ward, sterilization, verbal communication with the patient, using of intravenous cannulas, needles, syringes, devices for transfusion of infusion liquids, servicing of hospital rooms, first aid in life-threatening situations, using medical devices and equipment. Ten basic causes of the risk of adverse events were identified, among others: lack of trainings, of modern equipment, of staff, failure to comply with procedures, lack of staff supervision, poor quality of ancillary materials, lack of management commitment. Finally MedCARVER+Shock method and Pareto analysis usability has been confirmed but it appeared that it is time-consuming and requires support from skilled professionals. Several suggestions have been put forward to improve the utility of MedCARVER+Shock.

Keywords
quality management, safety, adverse events, nursing, healthcare, risk assessment.

Introduction

Quality management in the health care field ensures that patients receive an excellent provision of care. It is a function that health care organizations (such as medical clinics and hospitals) are responsible for performing to show their due diligence to taking optimal and safe care of their patients. By employing quality management applications to a health care doctors, nurses and administrators can benefit from identifying ways to improve internal processes that will ream more quality outcomes for their patients. It is not new that hospitalized patients are not always safe and are exposed to the risk of adverse events inherent in medical practice. Their identification and management increases the likelihood of achieving benefits and safety for patients [1]. The literature provides a variety of examples of how to define an adverse event (AE). It can be defined as an unintended injury or complication – only if it results in disability, death or a prolonged hospital stay (...) [2]. It might be an event or occurrence which becomes apparent during the delivery of care services and which has a negative or potentially negative impact on patient care [3]. The same characteristic can be found in the definition proposed by The Institute

of Medicine (IOM) in the USA, which indicates that an AE results in unintended harm to the patient by an act of commission or omission, rather than by the underlying disease or condition of the patient [4]. The Joint Commission [5], an independent, non-profit organization, which accredits and certifies more than 20,000 health care organizations and programs in the United States defines AE as an untoward, undesirable, and usually unanticipated event, such as the death of a patient. Moreover, The Joint Commission explains that it is not only patient that may be affected by an AE, but also an employee, or even a visitor in a health care organization [5]. The importance of assessing and managing risks in public health, including the risk of adverse events (AEs) has been recognized for several years and is one of the main topic while talking about health care quality [6]. This is highly desirable and reasonable, because, as confirmed by the results of studies in different countries, the rate of adverse events ranges from 3–17% [7] and is not decreasing [8]. It is also desirable and reasonable to implement a proactive approach in adverse events risk assessment, as recommended by the Joint Commission on the Accreditation of Healthcare Organization (JCAHO) in the United States (US). Regarding the above, the aim of the paper is to present MedCARVER+Shock method and its usability for adverse events risk assessment. It has been implemented in District Hospital X (DHX), in Poland, and has helped to identify the risk of adverse events of nursing activities, and has become a basis while developing the appropriate corrective actions in the Hospital within its quality management system.

Materials and methods

To assess the risk in relation to nursing activities the District Hospital X was selected. It is located in Poland, in the Kujawsko-Pomorskie province, in county Y, and financed with state budget funds, providing services to a county population of 130,000 inhabitants. The structure of DHX consists of 12 wards and offers 320 beds, admitting on average 12,000 patients every year. There are 21 specialist outpatient clinics and 11 laboratories. The hospital conducts monitoring and diagnosis with computer tomography, X-ray, ultrasound, endoscopy and mammography. The quality level of services is confirmed by "Hospital without pain" and ISO 9001:2008 certificates. The assessment was carried out from December 2010 to June 2011. The wards taken into account were: surgery – S, internal ward – I, gynecological-obstetrical ward – GO, anesthesia and intensive care – AIT, observation and isolation - OI, orthopedic – O, rehabilitation – R, neurology – N, palliative medicine – PM, lung diseases – LD, dialysis station – DS and emergency department – ED, and covered 888 activities carried out by all 190 nurses, working in the wards. During the assessment, methodology based on the MedCARVER+Shock method, cause and effect and the Pareto analysis were applied and the qualitative approach was used.

CARVER+Shock method which was originally developed by the US armed forces for the identification of areas exposed to terrorist attacks, and subsequently adapted by the US Department of Agriculture (USDA) and by the US Food and Drug Administration (FDA) for the purposes of defense against food terrorism [9, 10]. Considering the numerous advantages associated with the use of CARVER+Shock method in the military field, then in agriculture, in the food industry, and in flood risk assessment [11], it was concluded that it might also be a very good basis for adverse events risk assessment in the medical sector. During the assessment it was agreed that it would be necessary to set up and then cooperate with an expert working group (WG) composed of people holding appropriately high and esteemed positions and directly responsible for ensuring the quality of provided medical services and safety conditions related to patients' care, as follows: Deputy Medical CEO, Head Nurse, Quality Management Representative and Technical Director. During the assessment the authors and the representatives of the WG relied on a universal and accepted in Poland classification of nursing activities (NAs) developed in a national project entitled *"Classification of nursing activities and their implementation in the Polish healthcare system"*, carried out under the auspices of the Health Ministry in 2009. This classification specifies 888 activities as the material for further analysis in subsequent stages of the assessment. The MedCARVER+Shock method attributes taken into account as the basis for AEs risk assessment are presented in Table 1. As can be seen there are seven key attributes – Criticality, Accessibility, Recuperability, Vulnerability, Effect, Recognizability and Shock, assessed with the use of a scale from 1 to 10, whose definitions, adapted to the specificity of adverse events in health care have been derived from the original CARVER+Shock method.

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Table 1

MedCARVER+Shock attributes.

Attribute and its definition	Scale
CRITICALITY – *the measure of the impact of AEs on the safety of patients, staff, the health care facility; an AE is critical if its occurrence disturbs the safety of a patient (threat to life and/or health) and the safe provision of health care.*	
Threat to a patient's life and safety (death cases, exposure to chronic diseases, handicap) or to the whole facility.	9–10
Threat to a patient's health or safety (permanent loss of health), or to a part of the facility.	7–8
Threat to a patient's health (loss of health to be fully recovered).	5–6
Slight symptoms of a threat (slight damage to health).	3–4
No direct symptoms of a threat (no direct threats to patient safety; each symptom is timely identified, preventive measures are put in place).	1–2
ACCESSIBILITY – *potential possibility of AEs/dissemination/reoccurrence.*	
Unmonitored and unrecorded AEs; lack of recording methods, no data analysis; lack of knowledge about AEs, lack of procedures.	9–10
Events are monitored partially regarding the specific character of the NA (e.g. AEs in drug therapy, the operation of medical equipment), recorded occasionally; conclusions are available to narrow groups, limited access to information; information is too general.	7–8
Events are monitored partially regarding professional groups (e.g. selected nursing staff registers events); some events are recorded; conclusions are available to narrow groups only, limited access to information; information is too general.	5–6
Events are monitored and recorded; ongoing observation, of which patients, staff and visitors are aware; definitions of AEs and recording methods are determined; records are not analyzed; no conclusions to further actions; limited access to information.	3–4
Events are monitored; ongoing observation, of which patients, staff and visitors are aware; definitions of AEs, recording methods, data analysis, drawing conclusions, communicating methods are determined; information about events is available, no action is taken against persons reporting the events; procedures are developed and put in place.	1–2
RECUPERABILITY – *possibility to bring a patient back to the state prevailing before an adverse event.*	
Possibility of the death of a patient or of many patients.	9–10
Lack of the possibility of recovery, chronic disease.	7–8
Long recovery period > 1 year / sanatorium treatment, rehabilitation, specialist treatment.	5-6
Recovery period: 2 months – 1 year.	3–4
Short or very short recovery period < 2 months.	1–2
VULNERABILITY – *susceptibility of a certain patient (a specific group of patients) to negative consequences of an AE.*	
Patient health and NAs in a ward contribute to a large extent to AEs or make them unavoidable.	9–10
Patient health and NAs in a ward contribute to AEs.	7–8
Patient health and NAs in a ward have little impact on the occurrence of AEs.	5–6
Patient health and NAs in a ward have very little impact on the occurrence of AEs.	3–4
Probability of AEs is low or non-existent.	1–2
EFFECT – *number of direct losses incurred due to an AE, measured according to an adopted ratio (e.g. number of infections, number of diseases, number of re-surgeries, death rate).*	
Threat to the whole hospital.	9–10
Threat to a ward.	7–8
Threat to a few patients in one ward.	5–6
Threat to one patient in a ward.	3–4
Occasional event in the whole hospital.	1–2
RECOGNIZABILITY – *ease of identification / detection of an AE.*	
Impossible to recognize AE; AE, in consequence, not reported.	9–10
Difficult to recognize AE; AE reported rarely by the staff; permanent training required to identify and monitor AEs.	7–8
Rather difficult to recognize AE; AE not always identified, but if detected, AE is recorded and monitored; awareness training required.	5–6
Easy to recognize AE; AE reported and monitored.	3–4
Very easy to recognize AE; AE reported and monitored on an ongoing basis.	1–2
SHOCK – *cumulative measure of the impact of an AE on the life, health and psychical situation of patients.*	
Very extensive and permanent impact on the life, health and psychical situation of a great number of patients.	9–10
Extensive impact on the health and psychical situation of a number of patients.	7–8
Average impact on the health and psychical situation of some group of patients.	5–6
Little impact on the health and psychical situation of a small group of patients.	3–4
Very little impact or no direct impact on the health and psychical situation of patients.	1–2

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Results

Taking into account the principle of consensus, 888 NAs as typical ones, carried out in 12 hospital wards, were assigned and the risk ratio was calculated using the formula: R_{Med} = (C+A+R+V+E+R+SHOCK), as suggested in the original CARVER+Shock method. One can notice that the maximum value of R_{Med} is 70. The activities of which were $R_{Med} < 20$ were recognized as normal/everyday care, of which were $20 \leq R_{Med} > 30$ were defined as special care, and those $R_{Med} \geq 30$, as critical. In the opinion of the WG the adoption of such limits would provide reasonable security against AEs, and would not eliminate the possibility to tackle the activities with a lower R_{Med}, if need be. It was assumed that subsequent research would deal with the activities with $R_{Med} \geq 20$. Among the wards there were seven with only $20 \leq R_{Med} > 30$, observed in: S, GO, IO, R, PM, LD and DS, and five with $20 \leq R_{Med} \geq 70$. Considering the extent of the assessment and the limitations of the article, Table 2 presents only the results which refer to the rest of the wards – I, AIT, N, O, ED, but limited to those with $R_{Med} \geq 30$.

All the activities in all the studied wards with $R_{Med} \geq 20$ were summarized and classified, bearing in mind that the same activities are carried out in various wards repeatedly. Finally, seven basic groups of critical risk activities were identified regarding the highest R_{Med}. In this manner the following NAs were identified in descending order in terms of the risk ratio:

- NA1 – Admission of a patient to a ward.
- NA2 – Sterilization.
- NA3 – Verbal communication with a patient.
- NA4 – Use of intravenous cannulas, needles, syringes, devices for the transfusion of infusion liquids.
- NA5 – Hospital facilities servicing.
- NA6 – First aid in sudden life-threatening situations.
- NA7 – Operation of medical equipment/devices.

Table 2
MedCARVER+Shock attributes.

Ward	NA	C	A	R	V	E	R	SHOCK	R_{Med}
I	Operation of a cardiomonitor	5	2	9	4	4	2	7	33
	Handling of pressure mattresses	5	4	7	7	7	2	7	39
	Use of intravenous cannulas, needles, syringes, devices for the transfusion of infusion liquids	5	2	6	4	7	2	7	33
	Sterilization	6	2	6	7	7	2	7	37
N	Admission of a patient to a ward	10	8	6	10	4	7	8	53
	Isolation ward servicing	6	2	1	8	8	1	8	34
	Operation of a defibrillator	6	1	8	4	4	1	8	32
	Use of intravenous cannulas, needles, syringes, devices for the transfusion of infusion liquids	8	1	1	8	4	1	8	31
	Sterilization	8	1	1	8	4	1	8	31
AIT	First aid in sudden life-threatening situations	8	2	8	2	4	2	8	34
	Ward servicing	6	4	1	3	9	1	6	30
	Isolation ward servicing	10	4	1	3	9	1	6	30
	Patient room servicing	10	4	1	3	9	1	6	30
	Sanitary facility servicing	10	4	1	3	9	1	6	30
	Utility room servicing	9	4	1	3	9	4	2	32
O	Sterilization	5	5	5	5	5	1	6	32
ED	Use of intravenous cannulas, needles, syringes, devices for the transfusion of infusion liquids	5	5	5	5	5	5	5	35
	Sterilization	6	6	6	6	6	6	6	42
	Verbal communication with patients	5	5	5	5	5	5	5	35

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However, based on analyses of activities with $R_{Med} \geq 20$ it was noticed that they also include those that repeat very often in any ward in which they are carried out. The frequency of their occurrence has been recognized as the factor which aggravates the critical nature of the risk. For this reason the specification was additionally supplemented with:

- NA8 – Feeding of seriously ill patients.
- NA9 – Treatment of a patient with an immobilizing dressing.
- NA10 – Treatment of a patient with a tracheotomy tube.
- NA11 – Drawing samples of: blood, urine, swabs.
- NA12 – Administration of drugs.
- NA13 – Keeping records of treatment.
- NA14 – Transportation of an immobilized patient.
- NA15 – Prevention of inflammation of the skin.
- NA16 – The use of facilities for patients.

In this manner 16 NAs were selected for further studies, the aim of which was to identify the potential adverse events connected with them. The results obtained in this stage, based on the WG members' observations, knowledge and experience are presented in Table 3.

Table 3
The identification of potential AEs.

Nursing activity	Potential AE
NA1	patient stress, anxiety, distress
NA2	sensitisation, infection
NA3	patient stress, anxiety, distress
NA4	pain, complications
NA5	infection, complications
NA6	complications, patient stress, anxiety, distress, death
NA7	pain, complications
NA8	food intolerance, burn, choking
NA9	swelling, bedsores, ischemia,
NA10	bedsores, complications, death
NA11	pain, syncope, patient stress, infection
NA12	complications, patient stress, anxiety
NA13	complications
NA14	injuries, pain
NA15	bedsores, pain, complications
NA16	occurrence of contractures

As can be shown – complications, patient stress and anxiety are the most possible negative consequences of nursing activities in the studied hospital, but also the death of patients should not be underestimated. All of the potential adverse events were analyzed in terms of the potential causes. Finally, all the causes were grouped by similarity and arranged in a descending order to highlight those which contribute to the largest extent to the risk of AEs. In this case the Pareto analysis was applied, which made it possible to define the 8 key factors (the week points) which have the greatest impact on the risk of AEs, as follows: lack of modern equipment and IT infrastructure, nurses ignoring procedures, lack of staff supervision, haste and routine, lack of training addressed to nurses, understaffing, lack of management commitment and finally – the poor quality of materials used (see Table 4).

Table 4
The identification of potential AEs key causes.

Causes	N	%N	Cum%N
lack of modern equipment and of IT equipment	14	12.6	12.6
nurses ignoring procedures	13	11.7	24.3
lack of staff supervision	13	11.7	36
haste and routine	13	11.7	47.7
lack of training for nurses	11	9.9	57.6
understaffing	10	9	66.6
lack of management commitment	8	7.2	73.8
poor quality of materials	6	5.4	79.2
lack of management training	4	3.6	82.8
poor effectiveness of management	4	3.6	86.4
delayed deliveries of materials	3	2.8	89.2
lack of supplier evaluation	2	1.8	91
lack of periodic reviews of equipment	2	1.8	92.8
lack of materials	2	1.8	94.6
high workload	1	0.9	95.5
incorrect labeling of materials	1	0.9	96.4
non-handling of orders	1	0.9	97.3
outdated forms	1	0.9	98.2
poor procurement organization	1	0.9	99.1
poor management qualifications	1	0.9	100
In total	111	100	

As can be seen – complications, patient stress and anxiety are the most possible negative consequences of nursing activities in the studied hospital, but also the death of patients should not be underestimated. All of the potential adverse events were analyzed in terms of the potential causes. Finally, all the causes were grouped by similarity and arranged in a descending order to highlight those which contribute to the largest extent to the risk of AEs. In this case the Pareto analysis was applied, which made it possible to define the 8 key factors (the week points) which have the greatest impact on the risk of AEs, as follows: lack of modern equipment and IT infrastructure, nurses ignoring procedures, lack of staff super-

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vision, haste and routine, lack of training addressed to nurses, understaffing, lack of management commitment and finally – the poor quality of materials used.

Discussion and conclusions

In the case of every hospital and – above all – in the case of a patient and his/her family, adverse events are the result of nonconformities and proof of the lack of quality and patient safety in the delivery of health care. They can cause complications, stress, anxiety, the loss of a patient's life [12], health [13] and in the best case scenario – can contribute to financial losses [14] and the loss of hospital reputation [15]. They can also reinforce a sense of threat, of helplessness and can affect the general quality of life [16, 17]. AEs are used widely in health care quality measurement, in incidents reporting, occurrence screening or in dealing with complaints [18]. But it is important that healthcare institutions and hospitals take certain preventive and pro-active actions to avoid future problems and negative consequences. Moreover, to deliver an excellent service to patients, a hospital must most of all provide a training program and establish a clear vision about service excellence to nurses [19], although in most cases, the implementation of improvements depends on employees' initiatives, on self-discipline and on ethics [20]. The obtained results have shown some gaps in this area. But they have also offered the possibility to propose the necessary corrective actions aimed at improving current practices in DHX and at reducing the risk of AEs. The hospital managers were required:

- to analyze and verify the current set-up of nurses' work and duty rosters,
- to analyze and verify the current procedures regarding nurses' work and recruitment,
- to implement and reorganize workplace training sessions with ongoing verification of their effectiveness,
- to increase the commitment of direct superiors, with more supervision over activities performed by nurses and over compliance with procedures,
- to allocate funds for the necessary modernization and purchase of new equipment,
- to implement a more effective system and procedures for the recording and monitoring of AEs,
- to introduce an obligation to identify and record every AE – even the least important one,
- to set up a new procedure assessing the suppliers and set up new, more restrictive requirements regarding the quality of materials and on-time delivery,
- to introduce consistent and repeated training sessions addressed to all nurses at all wards, raising awareness and motivation,
- to introduce ongoing promotion of self-discipline, responsibility, commitment, pro-qualitative habits and work ethics, addressed to all staff, including top management.

Fortunately, all of the proposed actions have been implemented in DHX, however, not without resistance. Most of all, the results of the assessment vindicated the managers and staff of the existing risk of AEs. They have highlighted the weaknesses in health care delivery and areas for improvement. Finally, it took one year to manage all the suggested changes and initiatives, including changes in procedures, in the monitoring and reporting of AEs, in the training session agendas. It is noteworthy that in this case the change of attitude, including self-discipline and better involvement of the staff and management, was the most difficult task. The MedCARVER+Shock method applied in the studied hospital helped to identify nursing activities with the highest risk of adverse events. Most of all they were: the admission of a patient to a ward, the use of medical gloves, verbal communication with a patient, the use of intravenous cannulas, needles, syringes, devices for the transfusion of infusion liquids, the servicing of hospital facilities, first aid in sudden life-threatening situations and the operation of medical equipment/devices. It was also possible to indicate potential adverse events, like complications, patient stress and anxiety, but also patient death and based on that result to specify the most important causes of the risk, like: lack of modern equipment, nurses ignoring procedures, lack of staff supervision, haste and routine, training of nurses, understaffing, lack of management commitment and poor quality materials. Regarding the above, several corrective actions were proposed, whose role was to remedy and improve the current situation, and to identify serious problems to be managed, like:

- inappropriate qualifications and behavior of nurses resulting from a lack of training and supervision,
- excessive savings resulting in the reduction of employed nursing staff translating into excessive workloads, stress, haste and routine and thoughtless work,
- adopting the pricing criterion as the main prerequisite in the selection of suppliers of materials and of equipment impacting their poor quality, which results from the requirement to comply with the public procurement law,

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- very weak commitment of top hospital managers and their poor effectiveness in the execution of procedures in place,
- the reluctance of nursing staff to report adverse events for fear of official and legal consequences,
- general stereotypes and treating reported adverse events as snitching on colleagues, workmates and superiors.

To sum up, it was possible to confirm the usefulness of the own-developed MedCARVER+Shock method, originally invented and implemented by national defense in the form of CARVER+Shock, and reaffirm that it may also be applied in the healthcare sector, in hospitals for adverse events risk assessment. Nevertheless, MedCARVER+Shock is not free from limitations. First of all, it is labor-intensive and time-consuming. Secondly, it also requires support from very skilled professionals with extensive knowledge about the specificity of the particular ward. In clinical practice, in order to partly eliminate the time-consuming factor, it can be advisable to improve the process of the evaluation of attributes, e.g. by introducing a specialist computer program. It would also be valuable to additionally post the assessment results on the hospital internal Internet platform and to provide access to the results to relevant hospital staff. Based on that it would also be possible to define and update a virtual hospital map of areas carrying a special risk of AEs and to indicate areas and activities requiring special attention. We believe that the main advantages of the described MedCARVER+Shock method, resulting from the universal nature of attributes, and from a detailed scale, make the method useful. This method seems to be interesting for it promotes quality management practices, team work, exchange of experiences and the build-up of trust. In our opinion, it should be assisted by other quality management tools, like the Pareto analysis, because the information it offers should be treated as a starting point for further analyses and activities.

The proposed methodology can be recommended for other health care facilities – not only for hospitals and not only with regard to NAs. The phenomenon of adverse events refers to all activities in a healthcare institution, its staff, including doctors, and a wide spectrum of health care services. Nevertheless, future research is necessary to evaluate the actual effects of these recommendations in clinical practice. Nurses not only in Polish hospitals may use these findings as a basis for future research that will provide and expand knowledge on the risks connected with their everyday activities and on patient safety conditions, and hospital managers may use them as the starting point for the development of preventive actions within quality management system and the allocation of sources in terms of avoiding serious problems of adverse events detrimental to the welfare of the patient.

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