Identification and analysis of adverse events on the example of SP ZOZ in Swidnica

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Abstract. Identification of a series of various complications which happen during hospitalisation and then their classification enables understanding how many factors may influence their occurrence. The described solution shows an example of adverse event analysis along with an indication of preventive and prophylactic activities. The research material enabled finding 187 out of 1285 case histories in which an adverse event occurred, and also to establish its form (type). Then, as a result of general analysis directed at the total elimination or partial reduction of the identified events, 6 general recommendations were made.

Introduction

Adverse events may occur at every stage of health service provision by a medical entity, especially by a hospital services provider. We define them as: "harm to the patient's health caused during the diagnostic and/or treatment, not related to the natural course of the illness or the patient's condition, and also the risk of its occurrence" [3].

In order to identify and then establish a directory of the abovementioned events, hazards should be taken into account resulting not only from the activity of the medical personnel, the used devices, but also the drugs and medical treatments used in the course of therapy, and the diagnostic, therapeutic, nursing and rehabilitation procedures.

The development of current knowledge, science and technology, as well as the rapid development of medicine means that we can effectively cure

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illnesses that were previously incurable. Unfortunately this requires a series of invasive tests or a series of complicated surgical procedures. These procedures frequently significantly increase the risk of making a mistake.

Methods

The "black spots"[1] method used in this work was created by the team of prof. Michał Marczak [5, 8]. It consists of risk identification, ordering of threats, indication of possible causes and proposing preventive measures. Using the analysis of selected hospital stays as an example, an attempt was made to model patient safety measures. When constructing models, a series of various factors was taken into account, related e.g. to the specifics of the procedures, that is the performed procedures (in accordance with ICD-9), hospitalization time, amount of days with vascular catheter, number of surgical procedures, number of infections, number of bedsores, duration of surgery and critical events which have occurred during hospitalization, resulting in death/disability/longer stay etc.

Material

Research material including 1285 case histories of patients treated in the hospital in 2010 was obtained from SP ZOZ "Latawie" in Swidnica. Analysis was performed for selected stays at the following departments: Anaesthesiology and Intensive Care, Gynaecology and Obstetrics, Neurology, General Surgery, Neonatal Physiology and Pathology, Trauma and Orthopaedics Surgery and Cardiology. The collected data was additionally verified by cross-analysis of epidemiologic nurse reports with results of microbiological test cultures. All unclear issues and doubts were settled by the prof. Marczak's team through an additional, detailed analysis of discharge abstracts only or the entire case histories.

In order to establish which of the incidents which occurred may be considered to be adverse events, the obtained results were consulted with both

[1] It is a set of various methods and partial analyses (expert analyses, epidemiological monitoring etc.), frequently with various methodology, to which other components may be connected as needed. It is cyclical and has a block algorithm structure, which means that after removing the most dangerous "black spots" that are removable (taking into account the economical and organisational state of the unit) in another iteration on the subsequent level of hierarchy the risk analysis, selection of "black spots" etc. are performed again.

internal experts (hospital employees) and external experts (from outside the unit).

Results and discussion

The collected data enabled the establishing of all adverse events, which have occurred during the provision of analysed medical services. The obtained results can be presented as follows [Tab. 1–7]:

Tab. 1. Number and types of complications which happen during selected hospitalisations – Anaesthesiology and Intensive Care

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
30	11	supraventricular tachycardia	3	10
		gastrointestinal bleeding	1	3.33
		tracheotomy wound bleeding requiring surgical correction	1	3.33
		atrial fibrillation	2	6.67
		sudden cardiac arrest	9	30
		unplanned extubation	2	6.67
		obturation of the intubation tube	1	3.33
		pneumothorax	1	3.33
		acute respiratory failure	7	23.33
		infection of upper respiratory tract	2	6.67
		post-operative wound infection caused by *Acinetobacter baumanii*	1	3.33
		otitis media	1	3.33

source: own research

Tab. 2. Number and types of complications which happen during selected hospitalisations – Trauma and Orthopaedics Surgery

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
164	38	removal of thigh bone screw impossible	1	0.6
		infection of upper respiratory tract	1	0.6
		colliquative necrosis of tissue near post-surgery scar caused by MRSA[1]	1	0.6

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
		colliquative nercrosis of fatty tissue after tissue contusion	1	0.6
		skin necrosis above metal fasteners	1	0.6
		arm skin necrosis	1	0.6
		localised skin necrosis	1	0.6
		post-surgery ischaemia	9	5.5
		radial nerve paresis	1	0.6
		unsuccessful attempts to place the plug screw at the top of femoral nail	1	0.6
		dyspnoea with tachycardia	1	0.6
		bed sore in the area of sacral bone	1	0.6
		intra-gluteal area bed sore	1	0.6
		sacral area bed sore	1	0.6
		heel bed sore	1	0.6
		serum blisters on the lower legs	4	2.4
		fracture of the femoral bone (in the greater trochanter area) when implanting the endoprosthesis	1	0.6
		repeated hospitalisation caused by post-surgical wound infection after a previous procedure, caused by *Staphylococcus aureus*	1	0.6
		post-surgical respiratory and circulatory failure	1	0.6
		post-operative respiratory failure after general anaesthesia	1	0.6
		post-surgical wound dehiscence caused by MRCNS[2], MLSB[3]	1	0.6
		jumping out of the window and breaking both heel bones	1	0.6
		hip injury as a result of a fall	1	0.6
		serum and blood discharge from the post-surgical wound	1	0.6
		serum and pus discharge from the post-surgical wound	1	0.6
		serum discharge from the post-surgical wound	5	3
		urinary tract infection	1	0.6
		bone infection caused by *Streptococcus pyogenes*	1	0.6
		post-operative wound infection caused by *Acinetobacter baumanii*	1	0.6

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
		pulmonary embolism	2	1.2
		ischemic myocardial infarction	1	0.6
		post-puncture syndrome	2	1.2
		shedding of epidermis in both antecubital spaces	1	0.6

source: own research

[1] MRSA – methicyllin-resistant Staphylococcus aureus
[2] MRCNS – methicillin resistant coagulase negative Staphylococcus
[3] MLSB – Macrolide-Lincosamide-Streptogramin B

Tab. 3. Number and types of complications which happen during selected hospitalisations – Neonatal Physiology and Pathology

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
109	20	catarrhal infection of the nose and throat	2	1.8
		eye infection caused by *Escherichia coli*	1	0.9
		sudden cardiac arrest	1	0.9
		urinary tract infection caused by *Enterobacter cloace*	1	0.9
		urinary tract infection caused by *Enterococcus faecalis*	5	4.6
		urinary tract infection caused by *Enterococcus faecium* HLAR[1]	2	1.8
		urinary tract infection caused by *Escherichia coli*	4	3.7
		urinary tract infection caused by *Klebsiella pneumoniae*	1	0.9
		urinary tract infection caused by *Proteus mirabilis*	1	0.9
		urinary tract infection caused by *Staphylococus epidermidis* MRCNS, MLSB	2	1.8
		respiratory tract infection caused by *Pseudomonas aeruginosa*	1	0.9
		blood infection caused by *Morganella morgani*	1	0.9
		blood infection caused by *Staphylococcus epidermidis MRCNS*	1	0.9
		eye infection caused by *Haemophilus influenzae*	1	0.9

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
		ear infection caused by methicillin-susceptible coagulase-negative *Staphylococus*	1	0.9
		infection of the navel area caused by *Enterococcus faecalis*	1	0.9
		infection of the navel area caused by *E. coli*	1	0.9

source: own research

[1] HLAR – high-level aminoglycoside resistance

Tab. 4. Number and types of complications which happen during selected hospitalisations – General surgery

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
219	31	haematoma in the wound	1	0.46
		gastrointestinal haemorrhage	1	0.46
		sudden cardiac arrest	4	1.83
		respiratory failure	4	1.83
		psychotic symptoms	1	0.46
		post-surgical respiratory failure	3	1.37
		re-amputation	1	0.46
		repeated surgery due to the necessity of excising necrotic tissue around the post-surgical wound	1	0.46
		post-surgical wound abscesses	1	0.46
		retroperitoneal space abscess	1	0.46
		bile discharge	3	1.37
		bile discharge around the Kehr tube	1	0.46
		significant ileus	1	0.46
		post-operative wound infection caused by *Candida spp*	2	0.91
		post-operative wound infection caused by *Enterococcus faecalis*	1	0.46
		post-operative wound infection caused by *Escherichia coli*	2	0.91
		post-operative wound infection caused by *Klebsiella oxytoca*	1	0.46
		post-operative wound infection caused by *Pseudomonas aeruginosa*	1	0.46

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
		post-operative wound infection caused by *Staphylococcus aureus*	2	0.91
		post-operative wound infection caused by methicillin-resistant coagulase-negative *Staphylococcus*	1	0.46
		post-operative wound infection caused by *Streptococcus gr.* G	1	0.46

source: own research

Tab. 5. Number and types of complications which happen during selected hospitalisations – Gynaecology and Obstetrics

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
300	10	diarrhoea	1	0.33
		stomach aches, fluid in the abdominal cavity	1	0.33
		infection	1	0.33
		post-surgical wound bleeding requiring repeated surgery	1	0.33
		oedema of lower limbs	1	0.33
		paralysis of the femoral nerve	1	0.33
		vomiting and pain in the area of the pubic symphysis and epigastrium	1	0.33
		electrolyte and protein disorders	1	0.33
		post-surgical wound infection	2	0.67
		post-operative wound infection caused by *Escherichia coli*	1	0.33

source: own research

Tab. 6. Number and types of complications which happen during selected hospitalisations – Cardiology

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
325	48	anaemia	1	0.31
		3rd degree AV block with cardiac arrest – implantation of an electrode for temporary cardiac pacing	1	0.31

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
		serious cardiac decompensation	2	0.62
		ventricular tachycardia	1	0.31
		ventricular tachycardia with blood pressure decrease	1	0.31
		tachycardia with QRS complexes with a left bundle branch block morphology	1	0.31
		heart failure decompensation (IV NYHA[1]) accompanying severe aortic stenosis	2	0.62
		Cx dissection in PCI[2]	1	0.31
		short term consciousness loss episode	1	0.31
		hypokaliaemia	1	0.31
		hypotonia	1	0.31
		hypoglycaemia	1	0.31
		infection of the glans	1	0.3
		nosebleed	1	0.31
		haematuria	1	0.31
		heparine-induced thrombocytopenia	1	0.31
		sudden cardiac arrest	4	1.23
		ischemic cerebral stroke with right side paresis	1	0.31
		acute heart failure	1	0.31
		NYHA 3rd degree heart failure	1	0.31
		NYHA 4th degree heart failure	5	1.54
		decompensated diabetes	1	0.31
		hypotonia and low cardiac output symptoms	1	0.31
		pulmonary oedema	1	0.31
		waiting for equipment for the haemodynamic lab	1	0.31
		oliguresis	1	0.31
		acute respiratory and circulatory failure	1	0.31
		acute post-contrast kidney failure with hypotonia	1	0.31
		acute post-contrast kidney failure	5	1.54
		acute duodenal ulcer with haemorrhage	1	0.31
		coronary vessel perforation with bleeding into the pericardial sac and loss of arterial blood pressure	1	0.31

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
		psychomotor agitation of the patient (resulting from the removal of the catheter and IV cannula)	1	0.31
		superficial injury of the right forearm due to the patient slipping under the shower	1	0.31
		zoster	1	0.31
		technical problems with the angiograph	1	0.31
		revision of coronary vessels due to the dissection of the RCA proximal section[3] and constriction of the left posterior descending artery	1	0.31
		diabetic foot with tissue necrosis, hypoalbuminemia	1	0.31
		false aneurysm in the place the right femoral artery is punctured for coronarography	1	0.31
		TIA[4] during PCI	1	0.31
		vomiting	1	0.31
		infection of the central cathether insertion place by *Staphylococcus epidermidis*	1	0.31
		infection of the central cathether insertion place by *Staphylococcus aureus*	1	0.31
		wound infection caused by *Proteus vulgaris*	1	0.31
		pneumonia caused by *Klebsiella pneumoniae*	1	0.31
		pneumonia caused by *Neisseria spp.*	1	0.31
		pneumonia caused by *Pseudomonas aeruginosa*	1	0.31
		pneumonia caused by *Staphylococcus aureus*	2	0.62
		fainting without loss of consciousness	1	0.31
		significant hypercholesterolemia	1	0.31

source: own research

[1] NYHA – New York Heart Association
[2] PCI – percutaneous coronary interventions
[3] RCA – right coronary artery
[4] TIA – transient ischemic attack

Tab. 7. Number and types of complications which happen during selected hospitalisations – Neurology

Number of tested patients	Number of hospitalizations with complications	Type of complication/event	Number of events	Event frequency (%)
138	19	hyponatremia	1	0.72
		gastrointestinal bleeding	3	2.17
		massive oedema of limbs	2	1.45
		sudden cardiac arrest	2	1.45
		ischemic cerebral stroke	1	0.72
		heel bed sore	1	0.72
		sacral area bed sore	1	0.72
		acute haemodialysis caused by the increase of Ca, ionised Ca, creatinine and urea levels	1	0.72
		acute kidney failure in the course of infection	1	0.72
		ulceration of the bed sore in the area of sacral bone and buttocks	1	0.72
		tarry stool	1	0.72
		respiratory tract infection caused by *Staphylococcus haemolitycus*	1	0.72
		urinary system infection caused by *Acinetobacter baumanii*	1	0.72
		urinary system infection caused by *Escherichia coli*	2	1.45
		urinary system infection caused by *Klebsiella pneumoniae*	1	0.72
		urinary system infection caused by *Staphylococcus haemolitycus*	1	0.72
		urinary system infection caused by coagulase-negative *Staphylococcus*	1	0.72
		pneumonia	1	0.72
		pneumonia caused by *Acintetobacter baumanii*	1	0.72
		pneumonia caused by *Proteus mirabilis*	1	0.72

source: own research

The adverse events listed above (their occurrence) may be mostly prevented, taking into account in the further activity of the medical entity, the recommendations below.

General recommendations:

1. Improving the cooperation between non-surgical wards personnel and the anaesthesiology and intensive care ward personnel [7].

Justification:

In order to decrease the mortality indicator on non-surgical wards most important factor is to identify the patients with a high risk of complications or death early on. Appropriate, early, proper treatment of these patients enables avoiding many hazardous complications or even death. Good cooperation between the non-surgical wards personnel and the anaesthesiology and intensive care personnel enables appropriately early transfer of critically ill patients, especially in worsening clinical condition from a non-surgical ward to the anaesthesiology and intensive care ward, before the most significant complications occur, e.g. cardiac arrest, severe respiratory failure or circulation failure.

Advanced life support techniques available at Anaesthesiology and Intensive Care Wards (and not available at other wards) are intended to ensure temporary assistance to the basic vital functions of the patient, which were significantly disturbed in the process of a potentially reversible illness.

2. Improving the cooperation between the surgical wards personnel and the anaesthesiology and intensive care ward personnel [1, 7, 10].

Justification:

In order to decrease the mortality indicator on surgical wards the most important factor is to implement for the patients at risk appropriate preventive measures before the surgery, early identification by an anaesthesiologist of patients with an increased risk of death or post-surgical complications, and subjecting these patients to specialised anaesthesiological care directly after the surgery. The proposed solution is particularly justified by the conclusions from scientific research presented below: many post-surgery complications may be prevented by early risk identification and therapy, first 48 hours after the surgery is a critical period for high risk patients, planned transfer of high risk patients directly to intensive care wards should be seriously considered, since this could significantly decrease post-surgical mortality, among patients treated at a hospital in a non-optimum manner before accepting them at the intensive care ward an increased mortality was established, the longer the patient was present in the hospital before being accepted into intensive care, the higher was the mortality, many surgical patients could benefit from being transferred to an intensive care ward, but they are not given this opportunity, appropriate monitoring and pro-

per treatment of surgical patients may significantly decrease the mortality, some high risk patients should be assigned to intensive care ward in the post-surgery period, planned acceptance at the intensive care ward may significantly decrease mortality during the post-surgery period, elderly patients should be sent directly to intensive care wards after surgical procedures. For the elderly, the National Confidential Enquiry into Perioperative Deaths of 1999 recommends better cooperation between surgeons, anaesthesiologists and doctors with specialist knowledge on the care of elderly.

Appropriate cooperation between the surgical wards and the intensive care ward should not be confined only to patients qualified for surgical procedures (undergoing surgical procedures). It should also apply to patients undergoing diagnostic procedures, treated conservatively, or sick in days after surgeries (not under special supervision due to a surgery which they underwent). In such case the justification presented in item 1 is still valid for this group of patients.

3. Perform internal audit concerning the identification, monitoring and treatment of patients in a serious condition [2].

Justification:

In accordance with the RESUSCITATION GUIDELINES 2010, "early recognition of the patient's condition and prevention of circulatory failure form the first link of the survival chain. In case of a circulatory failure inside the hospital less than 20% of patients survive until they are discharged from the hospital. Circulatory failure occurring in patients on wards without monitoring is not a sudden or unpredictable event, nor caused by primarily cardiologic reasons. In this group of patients a slow and progressing deterioration of the general condition, including hypoxemia and hypotension, which remain unnoticed by medical personnel, or are diagnosed, but are not adequately treated. With many of these patients an unmonitored heart failure occurs, and the rhythm which causes it is usually not suitable for defibrillation. In the medical documentation of patients with whom UHF occurs, or who have suddenly required acceptance at the Intensive Care Ward (ICW) there is frequently evidence showing lack of diagnosis or lack of treatment of occurring respiratory and circulatory disorders. Insufficient care frequently includes: infrequent, late or incomplete assessment of basic vital signs; no knowledge concerning their proper values; the design of observation charts is not good enough; low frequency and specificity of "track and trigger" systems; insufficient number of medical personnel, and thus lack of ability to monitor the patients and provide them with better care. A frequent problem is the inefficient treatment of respiratory tract patency

disorders, circulatory and respiration disorders, inappropriate use of oxygen therapy, weak communication, lack of teamwork."

The audit should provide an answer to the following questions: Is the medical personnel provided with training concerning the symptoms of the worsening general condition of the patient and is there a need for rapid action in order to improve the existing situation? Do hospital wards use proper and regular monitoring of the patient's basic vital signs? Are there clear guidelines at the hospital wards, helping the medical personnel in early detection of the patient condition worsening? Is there a simple, unified system for calling for help at the hospital? Do severely ill patients receive proper and timely help?

4. Enter into the documentation of case history a serious condition identification chart ("early warning scale") [6, 9].

Justification:

Currently at many hospitals, in order to identify the patients requiring enhanced monitoring, treatment or specialised consulting, early warning scales are used, or criteria for calling a resuscitation team. Various scales (point systems) are used to assess the clinical condition of the patient, in which the help of the members of such a team is required. They include, among others, Early Warning Scoring System, Modified Early Warning Score. The action of the teams is based on both an alarming value of a single parameter and on obtaining an appropriate amount of points in a complex point system. Meeting these criteria calls the appropriate personnel to the patient's bed. The original Early Warning Scoring System was created on the base of the APACHE scale, which is used to assess the condition of patients at intensive care wards. The system is based on physiological changes, such as heart rate, breathing rate or blood pressure value.

5. Create a "rapid response team" in the hospital [4, 12].

Justification:

Studies conducted in many countries have shown that serious adverse events occur in 15–20% patients sent to the hospital. Up to 80% of adverse events is preceded by physiological or biochemical disorders (or irregularities), which occur a few hours, or even a few days earlier. Introducing this type of supervision over hospitalized patients has resulted in a reduction of the amount of sudden cardiac arrest cases at hospital wards, and sometimes also a reduction of mortality. An increased survivability of patients undergoing major surgery was shown. The National Institute for Health and Clinical Excellence has recommended the "placement of rapid reaction

teams" in the hospitals as one of the twelve actions used to prevent (reduce) the sickness and mortality rates as a part of 100 000 Lives Campaign.

6. In the hospital medical those procedures should be performed, in which the personnel has a significant experience and which are performed in large amounts [11].

Justification:

Size and type of the hospital may be important when performing some surgical procedures. In many studies the risk of death was lower and the length of hospital stay shorter in large clinical hospitals when compared to small clinical hospitals or non-clinical hospitals. The size of the hospital was the most important (the highest difference in survivability) in case of elderly and high-risk patients. The difference in mortality between a hospital with a small amount of beds, and a hospital with a high amount of beds amounted to more than 5% in case of lung or oesophagus resection, 2–5% in case of stomach resection, urinary bladder excision, surgery on a non-ruptured abdominal aortic aneurysm, replacement of mitral or aortic valve, and below 2% in case of colectomy, lobectomy or nephrectomy.

Conclusions

The described solution shows an example of adverse event analysis along with an indication of preventive and prophylactic activities.

Identification of a series of various complications which happen during hospitalisation and then their classification enables understanding how many factors may influence their occurrence. This factor may be both e.g. a team of specialists or a unit manager without appropriate qualifications, as well as defective medical equipment.

Unfortunately, gaining full knowledge about adverse events is not simple. Collecting all necessary information is a very difficult and arduous process. It requires not only appropriate experience, but also comprehensive knowledge about the organisational structure of a given facility, its specifics and character. However, it forms a necessary and required part of the process enabling not only the identification of the source of potential risks, but also indicate those, that cause the most damage and are important for the correct operation of the health care facility, including the safety of the patients.

The research material enabled finding 187 out of 1285 case histories in which a adverse event occurred, and also to establish its form (type). Then,

as a result of general analysis directed at the total elimination or partial reduction of the identified events, 6 general recommendations were made. It should be also noted, that the next stages of the study, not covered by this publication, include: ordering of threats, typing of black spots, creating the map of black spots, creating guidelines and detailed procedures applying to specific types of events classified as black spots, in the order they were assigned.

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