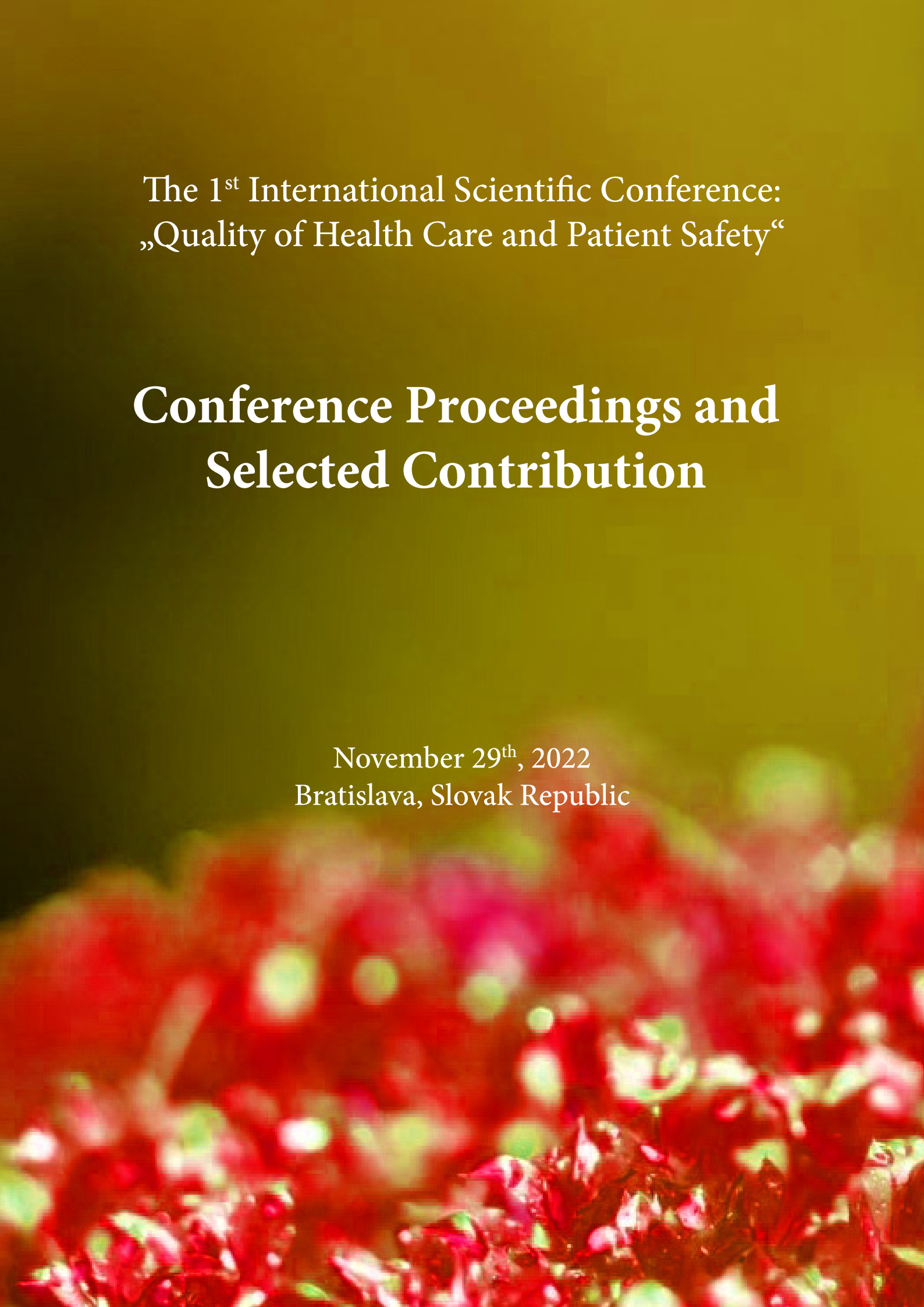
The 1st International Scientific Conference:
„Quality of Health Care and Patient Safety“

Conference Proceedings and Selected Contribution

November 29th, 2022
Bratislava, Slovak Republic



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CONTENTS

ANTIBIOTIC RESISTANCE GENES IN GUT MICROBIOTA OF HEALTHY INDIVIDUALS AND PATIENTS WITH LIVER DISEASE

Klára Cverenkárová [1], Petra Olejníková [2], Ľubomír Skladaný [3], Lucia Bírošová [1]

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Abstract

Introduction: The composition and functions of human gut microbiota contribute to the proper functioning of several important processes in the human body. Gut microbiota can also be inhabited by microorganisms resistant to antibiotics. They can enter the gastrointestinal tract from food, water, and the environment.

Aim: The main aim of this work was to detect and compare the presence of 6 antibiotic resistance genes (ARGs) in total DNA isolated from the stool samples of healthy individuals and patients with liver disease.

Methods: Samples of stool were collected from 147 healthy individuals and 35 patients with liver disease. Total genomic DNA was extracted with DNA isolation kit. Conventional PCR was used for detection of genes *bla$_{TEM}$, bla$_{SHV}$, bla$_{OXA}$, vanA, tetA* and *tetE*. PCR products were evaluated after gel electrophoresis.

Results: The most prevalent ARGs in healthy individuals were *bla$_{TEM}$* in 28.6 %; *vanA* in 23.1 %; *bla$_{OXA}$* in 10.2 %; *tetA* in 1.4 % and *bla$_{SHV}$* in 0.7 % of samples. In patients with liver disease the presence of ARGs was following: *vanA* 46.7 %; *bla$_{TEM}$* 24.4 %; *bla$_{OXA}$* 22.2 %; *tetA* 20.0 %; *bla$_{SHV}$* 13.3 % and *tetE* 4.4 %. Positivity for ARGs in healthy individuals was 49.0 % and in patients 77.8 %. *tetE* gene was detected only in patients.

Conclusion: Health of the individual influences the gut microbiota and the presence of ARGs. In our work, we detected ARGs in total DNA from stool of patients, but also from healthy individuals. The occurrence of ARGs was higher in patients which could be result of their health and in some cases antibiotic treatment.

Keywords: gut microbiota; antibiotic resistance genes; total DNA; PCR

Introduction, aim of work

The human gut microbiota is a collection of all microorganisms colonizing the gastrointestinal (GI) tract. Its composition and functions contribute to the proper functioning of several important processes in the human body. Its composition is diverse, and with the help of conventional cultivation techniques it is not possible to capture the entire range of microorganisms that make up the gut microbiota. In addition to beneficial microorganisms, however, the gut microbiota can also be inhabited by microorganisms resistant to antibiotics. They can enter the human intestinal tract from food, water, and the environment. Conditions in the human GI tract are suitable for the possible further spread of antibiotic resistance genes (ARGs) through horizontal gene transfer.

The main aim of this work was to detect and compare the presence of 6 ARGs in total DNA isolated from the stool samples of healthy individuals and patients with liver disease.

Methods

Samples of stool were collected from 147 healthy individuals from Bratislava and surrounding and 35 patients with liver disease hospitalized at 2nd SMU Department of Internal Medicine of F.D. Roosevelt University Hospital of Banská Bystrica. Total number of 45 stool samples was collected from the patients. At the time of the sampling, 20 of the patients were treated with antibiotics and 13 patients underwent fecal microbiota transplant. The numbers and characteristics of healthy individuals and patients are stated in Tables 1 and 2.

Tab. 1 Numbers and characteristics of the healthy individuals

	Vegetarians (V)	Meat-eaters (M)
n	79	68
Men	39	34
Women	40	34
Age span (y)	20-60	20-60
Average age (y)	40.33	40.87

Tab. 2 Numbers and characteristics of patients

	Patients
n	35
Men	23
Women	12
Age span (y)	19-66
Average age (y)	46.83

Total DNA from the stool samples was extracted with GenElute™ Stool DNA Isolation Kit (Sigma Aldrich, USA). The concentration of genomic DNA was evaluated with Nanodrop 2000 Spectrophotometer (Thermo Fisher Scientific, USA). Samples of genomic DNA were stored at -40°C until further analysis.

The presence of *bla*$_{TEM}$, *bla*$_{SHV}$, *bla*$_{OXA}$ (Dallenne et al., 2010), *vanA* (Depardieu, 2004), *tetA* and *tetE* (Ng et al., 2001) ARGs was detected in the DNA samples by conventional PCR. The reactions were previously tested and optimized according to the literature. The PCR products were then separated by gel electrophoresis and visualized by additional staining with GelRed.

Results and discussion

In the entire set of 147 total DNA samples from healthy individuals 94 resistance genes were detected. The most frequently represented resistance gene was *bla*$_{TEM}$ (28.6% of samples). Other resistance genes were determined in the following numbers: *vanA* (23.1%), *bla*$_{OXA}$ (10.2%), *tetA* (1.4%) and *bla*$_{SHV}$ (0.7%). The *tetE* gene was not present in healthy individuals. Multiple resistance genes (2 to 3) occurred simultaneously in several individuals.

A total of 59 resistance genes were present in DNA samples from patients. The *vanA* gene had the highest representation (46.7%) followed by *bla*$_{TEM}$ (24.4%). The higher presence of *bla*$_{OXA}$ (22.2%) and *tetA* (20.0%) genes was also detected.

An important indicator is the comparison of the results between the two groups. Since the patients were diagnosed with various liver diseases and several were treated with antibiotics, it was assumed that their gut resistome would be more diverse and the occurrence of resistance genes higher than in subjectively healthy individuals. Several studies indicate changes in the gut microbiome of patients with liver diseases. Also, treatment with antibiotics causes changes in the gut microbiota and creates selection pressure on a resistant population of bacteria.

We considered a positive sample as one in which at least 1 resistance gene was present. In healthy individuals, 49.0% of the tested samples were positive, while in patients 77.8%. At the same time, patients had significantly higher numbers of samples with multiple resistance genes. In the sample from one of the patients, we detected 5 of the 6 monitored resistance genes (except *tetA*).

Figure 1 compares the representation of determined resistance genes by type. Except for the bla_{TEM} gene, all other resistance genes were significantly higher in DNA samples from patients. The presence of the *tetE* gene was determined only in patients. The high occurrence of the *vanA* resistance gene in patients is explained by the results of the sequencing analysis of the composition of the gut microbiota of the patients. According to this analysis there was a significantly higher number of bacteria of the genus *Enterococcus* in the stool of patients than in healthy individuals - controls. The genus *Enterococcus* is a significant carrier of vancomycin resistance genes, which includes *vanA*.

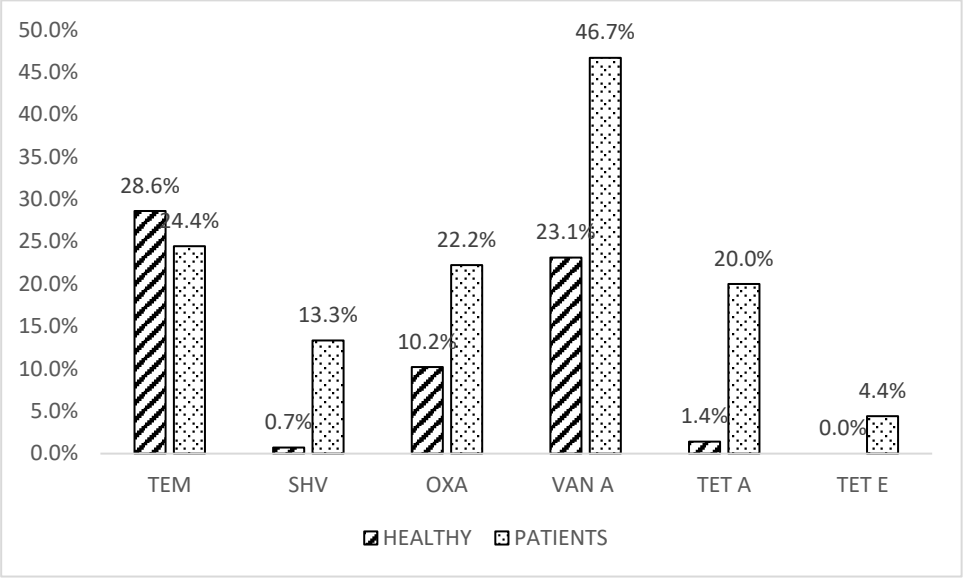

Fig. 1 Occurrence of detected ARGs in healthy individuals and patients with liver disease

Conclusion

Health of the individual influences the gut microbiota and the presence of ARGs. In our work, we detected ARGs in total DNA from stool of patients, but also from healthy individuals. The results show that the health condition and antibiotic treatment may have effect on the gut resistome of patients with liver disease, but also that antibiotic resistance genes are part of the gut microbiota of healthy individuals.

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THE IMPACT OF PATIENT DEATHS ON THE FEELINGS AND BEHAVIORS OF NURSING STAFF ON THE EXAMPLE OF SELECTED DEPARTMENTS OF THE RADOM SPECIALIST HOSPITAL

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Abstract

In the face of the phenomenon of death, no one remains indifferent. This also applies to people who encounter the death of a sick person almost every day at work. The aim of this study was to investigate the impact of patient deaths on the feelings and behaviors of staff in nursingego working at the Radom Specialist Hospital in Radom (Poland). The survey was conducted among 120 nurses. A diagnostic survey was used as a research method, and the tool used was an author's research survey. The questions included in the survey concerned the issue of how nurses perceive a patient's death and how it affects their emotions and the way they deal with them. The age and gender of nursing staff does not affect the emotional difficulties associated with the death of patients. Seniority has an impact on the emotional behavior of nursing staff in the event of patient death. Staff with shorter work experience take longer to analyze and reflect on the circumstances associated with this death. With the extension of seniority, the percentage of staff who think about these events after the patient's death decreases significantly. The incidence of deaths of patients in a given ward affects the willingness of nursing staff to change jobs. The fewer deaths in a given ward, the fewer respondents expressed a desire to change their workplace. On the basis of the conducted research, the main hypothesis has been confirmed that the death of patients has an impact on nursing staff working in selected departments of the Radom Specialist Hospital and may be one of the most difficult moments in the work of nursing staff. In addition, nursing staff have been shown to feel alone in this experience and expect more support in the form of education, training and the opportunity to talk to a psychologist or psychotherapist.

Keywords: death of patients, emotions, nursing staff, seniority

Introduction

Death is a natural stage in the life of every human being. According to the WHO, death is defined as the loss of a life with no chance of being restored. Before the death of a person occurs, he experiences agony, during which vital functions begin to disappear. Then there is clinical, brain, and finally cellular, or biological death [Sobczak & Janaszczyk. 2012; Bombik 2009].

Death is not a choice but a necessity. In addition, it is something that awaits every person. How to respond to this? How to prepare for it?

In the Middle Ages, there was even a literary genre called "ars moriendi" - "the art of dying". Anselm of Canterbury (1034-1109) wrote about the art of dying in his work "Admonitio morienti". In Poland, the work from the fifteenth century "The Conversation of Master Polycarp with Death" is known. The songs are intended to bring closer the subject of death and give advice and tips on how to prepare for it. In 1969, physician Elizabeth Kubler-Ross published a book called "Conversations about Death and Dying," which received great interest. The message of this book is that the dying person does not cease to be human and has the dignity due to everyone. The dying person has the same rights as everyone else to non-discrimination, autonomy and truth [Reinis 2007; Sánchez & Campus2005]

Seneca wrote that "one should learn to live all one's life" and "one should learn to die throughout one's life." The art of dying is the art of living" [Kulesza-Gierat 2012]. Often, however, dying is a dehumanized process, devoid of dignity. People prefer to avoid contact with the dying, with the bodies of the dead, because this arouses fear and even sometimes disgust in them.

In the old days, people died at home. Dying was ordinary. This involved some mourning rituals. Current dying in the hospital is separate from normal family life [Piątkowski & Majchrowska 2017; Costa et al. 2016]

We are now seeing the institutionalization and medicalization of dying and death. The death of a sick person most often occurs in hospitals, although these are not suitable places to die, because basically hospitals are aimed at restoring the health of the sick. It is a big mistake to think that the fact that someone dies is a failure of the hospital and the people working in it. In a hospital, people are not only born, treated, but also die [Cohen et al. 2006] Sick and dying patients are cared for by nursing staff who face suffering and death every day. This work is particularly emotionally burdensome for a large part of nurses.

The nursing profession is characterized by a high level of emotional demands. The basis of nursing work is direct contact with illness, human suffering, and often with death. These factors can lead to strong negative emotions: anger, disgust, contempt, fear and nervousness. These emotions lead to a decrease in well-being and dissatisfaction with professional and family life. People who come into contact with dying and dying are particularly susceptible to stress at work. Strong negative emotions can signal the occurrence of the phenomenon of burnout [Gugała 2003; Głowacka 2014].

Care for a dying patient includes: affirmation of dying as a natural process, not disturbing the rhythm of death, relieving pain and suffering, psychological help provided to the patient, maintaining his activity until death, supporting the family during illness and after death [Umiastowski 2009;] [Saunders 1998]

Medical staff are aware of the sufferings that the patient suffers and want to relieve him in these sufferings. Being present at a dying person is stressful for medical staff. This is all the more difficult because the modern concept of practical medicine does not prepare the staff caring for the patient to cope with the emotions associated with dying and death.

Purpose of work

The aim of the study was to determine the impact of patients' deaths on the feelings and behaviors of nursing staff working in selected departments of the Radom Specialist Hospital (Poland).

Main research problem: Does the death of patients affect the feelings and behaviors of nursing staff working in selected departments of the Radom Specialist Hospital?

Specific issues:

1. Does the seniority, age and gender of nursing staff affect the emotional difficulties associated with the death of patients?
2. Does the incidence of patient deaths in a given ward affect the willingness of nursing staff to change jobs?
3. Does the age of a dying patient make nursing staff cry because of helplessness and grief?
4. Does the seniority of nursing staff affect the perception of their role in the dying patient?
5. Does the seniority of nursing staff affect the ability to talk about death with patients?
6. Does seniority affect the behavior of nursing staff after the death of patients?

Main hypothesis: It was assumed that the death of patients has an impact on the feelings and behaviors of nursing staff working in selected departments of the Radom Specialist Hospital.

Detailed hypotheses:

1. The seniority, age and gender of nursing staff have an impact on the emotional difficulties associated with the death of patients.
2. The incidence of deaths of patients in a given ward affects the willingness of nursing staff to change jobs.
3. The seniority of nursing staff affects the perception of their role in the dying patient.
4. The seniority of nursing staff has an impact on the ability to talk about death with patients.
5. Seniority has an impact on the behavior of nursing staff after the death of patients.

Test materials and methods

The subject of the research was the nursing staff of the Radom Specialist Hospital (R.Sz.S.) in Radom (Poland). A diagnostic survey was used as a research method. The technique used in the study consisted in asking identical questions to a group of respondents. As a research tool, an original questionnaire was used. 120 respondents took part in the survey. The survey was conducted anonymously among nursing staff working at R.Sz.S. The questionnaire contained 27 questions. The first five questions concerned basic information on gender, age, education, seniority and place of work. The other questions focused on the emotions experienced by the nursing staff in connection with the death of patients.

In order to verify the hypotheses, an analysis of the relationships between the selected variables was carried out. The results obtained in the study were subjected to statistical analysis. Using the chi-square squared ($\chi 2$) test, the relationship between the selected questions in the survey and the variables, i.e. age, gender, seniority, was verified. The above analysis was aimed at verifying whether there was a relationship between the selected variables. According to the rules of statistics, if the result obtained is higher than the critical value read from the table, then it should be considered that there is a relationship, and this value is statistically significant. The significance level $p = 0.05$ was assumed, which means that the results $p < 0.05$ indicate the occurrence of significant relationships between the tested variables. The calculations were performed in statistical environment R version 3.5.5, PSPP and Microsoft Office.

Results

Research group

The largest group in the studied population were women - 112 people (93.33%). Men numbered 8 people (6.67%). The age structure among the respondents was as follows: in the age range: 23-30 there were 23 people (19.17%), 31-45 there were 43 people (35.83%), while over 46 there were 54 people (45%). The most numerous group were people over 46 years of age, the least numerous were people in the age range 23-30. The structure of education of the respondents was as follows: Medical High School graduated 17 people (14%), Vocational Study 9 people (8%), Bachelor of Nursing – 51 people (43%), Master of Nursing – 43 people (36%). The largest group were people with a Bachelor of Nursing education, the least numerous people after Vocational Studies. The division of respondents by seniority is as follows: people working 1-5 years accounted for 12 people of the surveyed population (10%), 6-15 years 26 people (22%), 16-25 years 31 people (26%), over 26 years 51 people (43%). The largest group were people working over 26 years, and the least numerous was the group working 1-5 years. The division of respondents by workplace is as follows: Internal Medicine Department 27 people (23%), Surgical Department 16 people (13%), ICU 18 people (15%), Cardiac Department 14 people (12%), Urology 15 people (13%), Neurology 21 people (18%), Nephrology 9 people.

Frequency of deaths in selected departments of the Radom Specialist Hospital in Radom

The incidence of deaths is as follows: 33 (28%) of respondents declare that deaths occur daily, several a week – 31 people (26%), less than once a week – 35 people (29%), very rarely – 21 people (18%).

Causes of death in patients

The causes of death were as follows: 41 (34%) of respondents indicated chronic diseases as the cause of death, 68 (57%) age-related diseases, 43 (36%) oncological diseases, 31 (26%) as a result of accidents / emergency, 9 (8%) surgical complications

Reactions of dying patients

The most common reaction of dying patients was anxiety – 74 (62%) of the person. Then fears of leaving their loved ones – 23 (19%) people, rebellion and inconsistency – 18 (15%) people, resignation – 9 (8%) people. The rarest reaction was regret for not fulfilling their roles in life – 6 (5%) people.

People whose presence is expected by patients in the terminal period of the disease

Patients in the terminal period of the disease most often expected the presence of a family – 104 people (87%), followed by close friends – 26 people (22%), a priest / clergyman – 23 people (19%). The least number of people wanted to have a doctor/nurse with them – 4 people (3%).

Acceptance of death by patients

The largest number of respondents – 59 people (49%) – said that it is difficult to say whether patients accept their death. Then, 38 people (32%) said they did not, and 23 people (19%) said that patients accept their death.

Ability to talk to patients about their departure

The largest number of respondents – 61 people (51%) – said that it is difficult to say whether patients can talk about their departure. Then, 47 people (39%) said they didn't, and 12 people (10%) said patients knew how to talk about their departure.

Willingness to talk to patients about their death

The largest number of respondents – 59 people (49%) – said they did not know if patients wanted to talk about their death. Then 42 people (35%) said they didn't, and 19 people (16%) said patients wanted to talk about their death.

People with whom the patient wants to talk about his death

According to the respondents, the people with whom the patient wants to talk about his death are: family – so stated 73 people (61%), friends – 14 people (12%), medical staff – 13 people (11%), priest / clergyman – 11 people (9%), psychologist – 1 person (1%). Of all the respondents in the study, only 9 people (8%) answered that they did not know who patients wanted to talk to about their death.

Nurses' readiness to be present at the death of the patient

The largest number of respondents – 53 people (44%) – said that it is difficult to say whether they are ready to be present at the patient's death. Then, 40 respondents (33%) said they did, and 27 people (23%) said they were not ready to be present at the patient's death.

Acceptance of the phenomenon of the inevitability of death by nurses

The largest number of respondents – 58 (48%) – said they did not think of death as an inevitable phenomenon. Then, 39 people (33%) said yes, and 23 respondents (19%) said they had not come to terms with death as an inevitable consequence of life.

Does the death of patients cause emotional difficulties among nurses

The largest number of respondents – 70 (58%) – declared that the death of patients is emotionally difficult for them. Then, 27 respondents (23%) said they were not, and for 23 people (19%) the death of patients is indifferent.

The presence of dilemmas among nurses after experiencing the patient's death

Respondents - 52 people (43%) - declared that after the death of patients dilemmas arise in them, the same number of people said that they do not think about the death of the patient and move on to further duties. The fewest respondents - 16 (14%) said that after the patient's death they do not have any dilemmas.

Emotions experienced by nurses at the time of a patient's death

At the time of the patient's death, the most respondents – 102 people (85%) – experience feelings of helplessness, 34 people (28%) regret, anger – 14 people (12%), relief – 11 people (9%). For 9 people (8%) the death of the patient is an indifferent phenomenon.

Percentage of nurses who cried for helplessness and grief over a patient's death

Among the respondents, 43 people (36%) said they had not cried because of the patient's death, while 41 people (34%) responded by crying and 36 people (30%) did not remember the situation.

Does the age of the dying patient affect emotions among nurses

According to 97 respondents (81%), the age of the dying patient affects their emotions, and for 23 people (19%) it does not matter.

Do nurses remember exceptional situations related to the death of patients

Among the respondents, 96 people (80%) remembered exceptional situations related to the death of patients, and 24 people (20%) said that they did not remember such situations.

Can nurses talk about death with patients?

The largest number of respondents – 68 people (55%) – declared that it is difficult to say whether they can talk to patients about death. Then, 36 people (32%) said they didn't, and 16 people (13%) said they could talk to patients about death.

According to the opinion of nurses, does the education system prepare for talks about the death of patients?

The largest number of respondents – 55 people (46%) – declared that it is difficult to say whether the education system prepares for talks about death. Then, 33 people (28%) said they

did not, and 32 people (26%) said that the education system prepares for conversations about death.

Nurses' opinion on their role in the dying patient

According to the majority of respondents (80 people, which accounted for 67%), nursing staff should play a supportive role for the patient and his family in the dying patient. In contrast, 40 people (33%) said that the role of nursing staff should include only patient care processes.

Values of contact with a dying patient

According to the largest number of respondents – 56 (47%) – contact with a dying patient teaches humility towards life, 48 people (40%) appreciation of their own health, 16 people (13%) empathy. None of the respondents declared that contact with a dying patient does not bring any value.

Does the number of deaths affect respondents' willingness to change jobs?

The vast majority of respondents – 56 people (47%) – would be happy to change jobs where the number of deaths is lower, 44 people (37%) did not think about it, and 20 people did not say it.

Behaviour of nurses after the patient's death

Most respondents – 48 people (40%) – try to forget about the event of the patient's death as soon as possible. 40 people (33%) do not think about this fact, and 32 people (27%) think about what happened.

Statistical analysis

Based on the obtained chi-square score ($\chi 2 = 2.628$) and the level of significance ($p = 0.622$), there was no significant relationship between emotional difficulties associated with the death of patients and age. Both those aged 23 to 30 years were the most common (69.6%) to have emotional difficulties related to the death of patients and those over 45 years of age were most likely to have emotional difficulties related to the death of patients. Also, people aged 31 to 45 years were most common, but to a lesser extent (51.2%) to have emotional difficulties associated with the death of patients. There was no significant relationship between the emotional difficulties associated with the death of patients and the sex of the nursing staff ($\chi 2 = 2,220$) and the level of significance ($p = 0.330$). It can be concluded that the most common in both women (59.8%) and men (50%) had emotional difficulties associated with the death of patients. In contrast, there was a significant relationship between emotional difficulties associated with the death of patients and seniority ($\chi 2 = 40.595$) and the level of significance

(p = 0.001). 91.7% of those with a seniority of 1 to 5 years and 92.4% of those with a seniority of 6 to 15 years reported a significant relationship between the emotional difficulties associated with the death of patients and the length of service. As seniority increased, emotional difficulties decreased. Emotional difficulties associated with the death of patients occurred in only 27.5% of those with the longest tenure, i.e. over 25 years of age (Table 1).

Tab.1 Relationship between age, gender, seniority of nurses and the occurrence of emotional difficulties related to the death of patients

			Age range			Test result
			23 – 30 years	31 – 45 years	over 45 years	
Emotional difficulties	is the impact	N	16	22	32	$\chi^2 = 2{,}628df = 4p = 0{,}622$
		%	69,6%	51,2%	59,2%	
	has no effect	N	3	11	13	
		%	13,0%	25,6%	24,1%	
	indifferent	N	4	10	9	
		%	17,4%	23,2%	16,7%	
Total		N	23	43	54	
		%	100,0%	100,0%	100,0%	

			Sex		Test result
			Women	Men	
Emotional difficulties	is the impact	N	67	4	$\chi^2 = 2{,}220df = 2p = 0{,}330$
		%	59,8%	50,0%	
	has no effect	N	26	1	
		%	23,2%	12,5%	
	indifferent	N	19	2	
		%	17,0%	37,5%	
Total		N	112	8	
		%	100,0%	100,0%%	

			Seniority				Test result
			1 – 5 years	6 – 15 years	16 – 25 years	above 25 years	
Emotional difficulty	is the impact	N	11	24	21	14	$\chi^2 = 40{,}595df = 6p = 0{,}001$
		%	91,7%	92,4%	67,7%	27,5%	
	has no effect	N	0	1	4	22	
		%	0,0%	3,8%	12,9%	43,1%	
	indifferent	N	1	1	6	15	
		%	8,3%	3,8%	19,4%	29,4%	
Total		N	12	26	31	51	
		%	100,0%	100,0%	100,0%	100%	

χ^2 – test statistics; *df* – degrees of freedom; *p* – statistical significance

According to the analysis of the chi-squared test (χ2 = 35.722) and the level of significance (p = 0.001), a significant relationship was noted between the incidence of death and the desire to change jobs (Table 2). A strong desire to change jobs occurs most often in wards where the incidence of death occurs daily (72.7%). As the incidence of death decreases, so does the tendency to change jobs. The least willingness to change jobs is recorded in the case of death less than once a week (22.9%) and in the case of a very rare occurrence of death (28.6%).

Tab. 2 Relationship between the incidence of deaths andthe willingness of nursing staff to change jobs

			Incidence of deaths				Test result
			Every day	a few a week	less than a once week	very rare	
Willingness to change jobs	Yes definitely	N	24	18	8	6	$\chi^2 = 35,722$ $df = 6$ $p = 0,001$
		%	72,7%	58,1%	22,9%	28,6%	
	No	N	3	4	4	9	
		%	9,1%	12,9%	11,4%	42,8%	
	I don't think about it	N	6	9	23	6	
		%	18,2%	29,0%	65,7%	28,6%	
Total		N	33	31	35	21	
		%	100,0%	100,0%	100,0%	100%	

χ^2 – test statistics; *df* – degrees of freedom; *p* – statistical significance

Based on the obtained chi-square score (χ2 = 18.584) and the level of significance (p = 0.005), a significant relationship was noted between the seniority of nursing staff and the ability to talk about the patient's death (Table 3).

Tab. 3 Relationship between seniority and the ability to talk about death with patients

			Seniority				Test result
			1 – 5 years	6 – 15 years	16 – 25 years	above 25 years	
Conversation skills	Yes	N	2	4	4	6	$\chi^2 = 18,584df = 6p = 0,005$
		%	16,7%	15,4%	12,9%	11,8%	
	No	N	7	13	11	7	
		%	58,3%	50,0%	35,5%	13,7%	
	It's hard to say	N	3	9	16	38	
		%	25,0%	34,6%	51,6%	74,5%	
Total		N	12	26	31	51	
		%	100,0%	100,0%	100,0%	100%	

χ^2 – test statistics; *df* – degrees of freedom; *p* – statistical significance

Staff with shorter work experience usually do not have the ability to talk about the patient's death. This situation applies to 58.3% of staff with a seniority of 1 to 5 years and 50% of staff with a seniority of 6 to 15 years. As seniority increases, the percentage of staff who do not have the ability to talk about a patient's death decreases. The lack of ability to talk about the patient's death affects only 13.7% of people with seniority over 25 years.

A significant relationship was noted between the seniority of nursing staff and the perception of their role in the dying patient (Table 4), the result of the chi-square test ($\chi 2 = 10.997$) and the level of significance ($p = 0.012$). Staff with the shortest seniority, i.e. from 1 to 5 years, most often (58.3%) perceive their role with a dying patient as a nursing role only. Staff with the longest work experience, i.e. over 25 years of age, most often (82.4%) perceive their role in the dying patient not only by completing care procedures, but also by supporting the patient and his family in these difficult moments.

Tab. 4 Relationship between the seniority of nurses and the perception of their role in a dying patient

			Seniority				Test result
			1 – 5 years	6 – 15 years	16 – 25 years	above 25 years	
Role of staff	Care only	N	7	11	13	9	$\chi^2 = 10,997$ $df = 3$ $p = 0,012$
		%	58,3%	42,3%	41,9%	17,6%	
	Supporting the patient and his family	N	5	15	18	42	
		%	41,7%	57,7%	58,1%	82,4%	
Total		N	12	26	31	51	
		%	100,0%	100,0%	100,0%	100%	

χ^2 – test statistics; *df* – degrees of freedom; *p* – statistical significance

Based on the obtained chi-square score ($\chi 2 = 13.915$) and the level of significance ($p = 0.031$), a significant relationship was noted between the seniority of nursing staff and the behavior of nursing staff after the patient's death (Table 5). Staff with a shorter seniority most often think about what happened after the patient's death. On the basis of research, it was found that as many as 50.0% of staff with a seniority of 1 to 5 years and 42.3% of staff with a seniority of 6 to 15 years, after the patient's death, think about what happened. With the extension of seniority, the percentage of staff who think about what happened after the patient's death decreases significantly. Only 12.9% of staff with 16 to 25 years of experience think about what happened after the patient's death.

Tab. 5 Relationship between seniority of nurses and impact on the behaviour of nursing staff after the patient's death

			Seniority				Test result
			1 – 5 years	6 – 15 years	16 – 25 years	above 25 years	
Personnel behavior	Quickly forgets	N	2	9	18	19	$\chi^2 = 13,915$ $df = 6$ $p = 0,031$
		%	16,7%	34,6%	58,1%	37,2%	
	Thoughts about what happened	N	6	11	4	11	
		%	50,0%	42,3%	12,9%	21,6%	
	Doesn't think twice	N	4	6	9	21	
		%	33,3%	23,1%	29,0%	41,2%	
Total		N	12	26	31	51	
		%	100,0%	100,0%	100,0%	100%	

χ^2 – test statistics; *df* – degrees of freedom; *p* – statistical significance

Discussion

Nowadays, when there is a cult of youth, strength, beauty and perfect health, it is difficult to talk about dying and death. Death is not media, death sells badly, and yet it is inevitable and concerns everyone. Older, sick people often end up in the hospital, where the final moment of their lives comes. It happens that families are not always able to cope with the care of their loved ones who are sick and in the terminal period of illness. We have no right to accuse and judge anyone, because caring for a sick and dying person is difficult physically and emotionally. Not every person can meet this [Walden-Gałuszko 2000, 2014; Kowalczyk 2012]

In the hospital there are people who take care of sick dying people, they are at their death. It is the nursing staff who every day stand at the bedside of the sick person, are at his call, accompany him in his suffering. This is not an easy mission. Nurses are people like others, they have their own emotions, but because of their profession, they take care of the sick in difficult moments of their lives. This work leads to exhaustion not only physically, but also emotionally [Głowacka 2014], [Zheng, Lee, Bloomer 2018].

Dealing with the death and loss of a patient is considered one of the most difficult and demanding in clinical practice. Nursing staff who cannot cope with this traumatic experience on their own are also unable to support dying patients and their families in this experience [Zheng, Lee, Bloomer 2018].

The topic of coping with the death of patients by nursing staff is taken up in many studies around the world. Areas of this research include, but are not limited to, boundary setting,

reflection, crying, beliefs, life and professional experience, that is, about internal resources. External resources, i.e. conversation and being heard, spiritual practices and education [Zheng, Lee, Bloomer 2018], [Akard, Hendrick-Ferguson, Gilmer 2019] were also studied.

Research undertaken by other authors focused on the analysis of the skills that are used by nursing staff in dealing with patient loss. Based on these studies, it was concluded that most staff do not cope with patient loss and expect more preparation and support resources to help them cope with this problem [Zheng, Lee, Bloomer 2018].

Starting from the above premises, it was decided to investigate the impact of patients' deaths on nursing staff working in R.Sz.S. Own research did not show a significant relationship between the age and gender of the respondents and emotional difficulties associated with the patient's death. The next relationship studied was the impact of seniority on the emotional difficulties experienced by respondents in connection with the death of a sick person. In this study, a significant relationship was noted, as well as between the incidence of deaths in a given ward and the desire to change jobs. Other authors in their study addressed how nurses' personal approach to death was related to their attitude toward caring for dying patients. The results suggest that it is common for nurses to use avoidance to cope with their own fear of death. An analysis of other authors' research has also shown a link between culture and religion and attitudes toward death and care for the sick [Braun, Gordon, Uziely 2010].

Many scientists in their research have proven that the death of patients is perceived differently by nursing staff working in treatment wards and ICUs, where patients die suddenly, as a result of accidents and injuries. The death of these sick people is a more difficult experience for nurses. The death of palliatively treated patients is perceived differently when their suffering is seen. The departure of such patients is often associated with sadness, but also with relief. [Akard, Hendrick-Ferguson, Gilmer 2019] [Gagnon, Duggleby 2014].
Own research on the seniority of nursing staff and the ability to talk about death with patients and the perception of their role in the dying patient, as well as behavior after his death, showed the existence of a significant relationship.

The death of a patient is a common situation in the professional work of nurses. Despite the composure and calmness of the nursing staff, such events provoke emotions. The most common are feelings of helplessness (85%), regret (28%), anger (12%), and sometimes relief (9%) that someone's suffering has ended. Similar conclusions were drawn from a study conducted in Turkey, where 37.5% of nursing staff felt grief about the patient's death, 34% - helplessness, 10.5% - fear, 10.7% - anxiety [Cevik, Kav 2013]. These factors cause nurses to

minimize contact with the dying patient and meetings with his family. Most nursing staff (82%) did not feel comfortable talking about death with their patients [Cevik, Kav 2013]. These conclusions were confirmed in their own research, where only 16% of respondents confirmed the ability to talk about death with a sick person. Emotions and experiences related to the death of the patient are transferred to the family environment, which causes guilt and depression. Nurses talk among themselves about the death of a sick person, they think about its inevitability. Often there is a defense mechanism, that is cutting off from the fact of the death of the sick person. There is denial, suppression, denial and rationalization of the events that have occurred. This is a form of protection against emotional exhaustion. Sometimes such an attitude arouses misunderstanding and wrong accusation of lack of empathy. Strategies for avoiding or "disconnecting" emotionally have been demonstrated in studies by other authors [Bailey, Murphy, Porock 2011]. It can therefore be concluded that such behavior and coping strategy as is associated with caring for the dying person is common among nursing staff around the world.

The current model of nurses' education in Poland does not fully shape the ability to cope with a difficult situation, which is the death of a sick person. This is also confirmed by research in the United States, where education also does not take into account this problem, which is inherent in the work of a nurse [Harris, Flowers, Noble. 2011]. Therefore, representatives of this professional group use at most the usual methods of coping with stress at work. Most nurses expect support from a psychologist and overworking their emotions, which were born after the patient's garbage [Nyklewicz, Krajewska-Kulak 2008]. A study conducted in Turkey showed different results – 85% of nursing staff said that education in the care of a dying patient is sufficient [Cevik, Kav 2013].

Own research has shown a relationship between seniority and the ability to cope with emotional difficulties. Other authors have come to similar conclusions in their research, who have found that longer work experience better affects the ability to cope with difficulties and emotions after a patient's death [Nordgren, Olson 2004].

From the conducted research of my own and other authors, it can be concluded that the death of a patient may be one of the most difficult moments in the work of nursing staff.

Applications

The age and gender of nursing staff does not affect the emotional difficulties associated with the death of patients. Seniority has an impact on the emotional behavior of nursing staff in the

event of patient death. Staff with shorter work experience take longer to analyze and reflect on the circumstances associated with this death. With the extension of seniority, the percentage of staff who think about these events after the patient's death decreases significantly. The incidence of deaths of patients in a given ward affects the willingness of nursing staff to change jobs. The fewer deaths in a given ward, the fewer respondents expressed a desire to change their workplace. The seniority of nursing staff affects the perception of their role in the dying patient. The staff with the longest work experience believes that in addition to the nursing function, its role is also to support the patient and his family. The seniority of nursing staff has an impact on the ability to talk about death with patients. The longer the length of service, the greater the number of respondents declared the ability to talk about death with the sick. The current model of nurses' education in Poland does not teach the ability to cope with a difficult situation, which is the death of a sick person.

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ASSESSMENT OF THE LEVEL OF KNOWLEDGE OF PREGNANT WOMEN ON THE TOPIC OF BREASTFEEDING

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Abstract

Breastfeeding is the main and most important way for a mother to meet her baby's basic need – hunger. Numerous studies indicate that this is also the most effective way, with positive consequences for both the child and the mother. Natural breast milk has a full range of properly matched ingredients for the proper development of the baby. Given its importance in providing the child with adequate nutrition, it is important that nursing mothers have an appropriate degree of knowledge about it and properly implement the acquired knowledge into practice. The aim of the study was to assess the level of knowledge of pregnant women about breastfeeding depending on social and demographic factors. Respondents were asked about appropriate methods, advantages, contraindications to breastfeeding and how to store breast milk. The survey was conducted among 102 pregnant women in the period April-May 2019 using the diagnostic survey method. Most of the respondents represented the age group between 26 and 35 years of age, had a good financial situation, had one or more births, had a vocational education and lived in the city. More than half of the respondents (57.80%) rated the level of their knowledge about breastfeeding as very high, but more than a quarter of them did not have any knowledge on this subject. The vast majority of women were aware of the benefits of breastfeeding for the baby, although a smaller proportion of them were aware of the benefits for the mother. The study showed that the majority of women surveyed (73.4%) have good or very good knowledge about breastfeeding. Additionally, the study found no relationship between the level of knowledge and sociodemographic factors.

Keywords: breastfeeding, baby development, lactation, breast milk

Introduction

Natural breast milk is an inseparable link in the model of proper nutrition of infants. All organizations dealing with the subject of child nutrition agree that it should be the main element of child nutrition [Florea 2014]. The World Health Organization recommends feeding the child at least until the age of 6 months with the possibility of extending the feeding if the mother and child agree to it [Zielińska et al. 2017]. Basing the child's nutrition model on breast milk is important due to the fact that feeding it brings pro-health benefits, both for the child and the mother, with a relatively small number of contraindications. Breast milk is considered by the medical and scientific community to be a unique blend ideally suited to the needs of the baby [Rouw et al. 2018]. Numerous studies indicate that a diet based on breast milk not only provides the child with all the necessary nutrients for proper psychomotor development, but also has an immunoprotective effect, protecting the child against many diseases. Children fed breast milk are less likely to develop gastrointestinal, respiratory and urinary tract infections and inflammations, and an association has been shown between breast milk intake and reduced incidence of leukemia, asthma, as well as obesity and diabetes in adulthood [Yasmeen et al. 2019; Eidelman et al. 2012]. Contrary to popular belief, the beneficial effect of breastfeeding is not limited only to the baby, but also has a real effect on the mother's body. Recent studies show that breastfeeding is an important factor in reducing the risk of cancer such as breast, ovarian, uterine and breast cancer [Turck et al. 2013; CDC 2021]. In addition, breastfeeding women have been shown to have a reduced risk of type II diabetes, cardiovascular disease and heart disease [Ciampo and Ciampo, 2018; Eidelman et al. 2012]. What's more, breastfeeding creates a bond between mother and baby on an emotional and hormonal level, through increased secretion of prolactin in the mother's body, making her more patient, understanding and affectionate in caring for the baby. An additional factor that may prompt many women to breastfeed is the fact that this way of feeding the newborn promotes a faster return to the original weight, and also reduces the risk of osteoporosis and rheumatoid arthritis [Ciampo and Ciampo, 2018; Eidelman et al. 2012]. Situations in which breastfeeding is contraindicated are rare, although they are a clinically important group of cases. They can be divided into absolute and temporary contraindications on the part of the mother and absolute on the part of the child. If feeding is not recommended due to the mother's medical condition, it is possible to express milk and/or start feeding again after switching on/off the appropriate therapy.

Contraindications to breastfeeding by mother [Amoo 2019; Florea 2014]

Contraindications from the mother's side:

Absolute:

- AIDS (acquired immunodeficiency syndrome)
- malignant breast tumor,
- severe clinical condition of the mother,
- hepatitis C during viraemia,
- active untreated tuberculosis,
- infection or carrier of *HIV (human immunodeficiency virus*), *HTLV I* and *HTLV II* (human T-lymphotropic virus type 1 or type 2),
- maternal intake of drugs absolutely contraindicated during breastfeeding,
- drug addiction,
- fourth degree circulatory failure – NYHA IV,
- severe mental illness,
- changes in the nipple area as a result of smallpox,
- herpes,
- syphilis,
- infectious impetigo,
- metastasis of malignant tumors,
- acute mastitis

Relative:

- hepatitis A and B,
- measles,
- smallpox,
- immunoglobulin intake (if there are no changes in the warts),
- infection with streptococcus type A,
- MRSA infection (*Staphylococcus aureus*),
- gonorrhea – breastfeeding is possible within 24-72 hours from the introduction of appropriate treatment,
- *Cytomegalovirus (CMV - (venereal* disease)) – a special contraindication when feeding premature babies,

- infection with *Haemophilus influenzae* type B,
- ongoing brucellosis,
- use of drugs or exposure to radioactive materials

The process of preparing a woman for breastfeeding is mammogenesis, which consists in morphofunctional differentiation of the mammary glands and the specialization of the cells located there for the production and secretion of milk. After completing mammogenesis, another of the processes begins - lactogenesis, which can be divided into 3 stages: lactogenesis I, running from the 16th week of pregnancy, lactogenesis II, starting about 4 days after delivery and its final stage - lactation (lactogenesis III). Lactation is characterized by stabilization of the milk production process and depends on the signals running on the neuroendocrine route [Florea 2014]. Stimulation of the nipple by the baby during feeding stimulates the production of two hormones: oxytocin, which causes the smooth muscles of the nipple to contract, leading to the outflow of milk, and prolactin, whose increase in blood concentration stimulates the production of food. The final stage of lactogenesis is involution leading to the disappearance of cells responsible for the production of breast milk. Despite the significant benefits of natural feeding, there are many factors that prompt mothers to stop breastfeeding [Furman 2018]. The main of them are broadly understood problems with lactation. These include, among others, pain and damage to the nipples as a result of feeding and an apparent deficiency of the milk produced. Many women, due to insufficient knowledge of the physiology of lactation, introduce artificial milk mixtures into the diet based on breast milk for fear of insufficient amount of food produced. Before making changes to the child's diet, a woman should conduct a number of studies assessing the validity of her fears and, in consultation with a pediatrician, assess the need to make modifications to the diet. The most important factor assessing the effectiveness of the diet used is the proper psychomotor development of the child and proper weight gain. An important element determining the proper nutrition of the child is the mother's knowledge about the correct breastfeeding technique and proper nutrition [Wierzejska 2017].

Aim of the work

The aim of the study was to assess the level of knowledge of pregnant women about breastfeeding depending on social and demographic factors.

The main research problem was to get an answer to the question: Do pregnant women have knowledge about natural feeding?

In order to achieve an answer to the main problem issue, the following questions were formulated:

- Does knowledge about natural feeding depend on the number of births?
- Is knowledge about natural feeding dependent on social and demographic factors?
- What are pregnant women most afraid of?
- Do the women studied know how to stimulate lactation?
- Where do women get information about natural feeding?

The following research hypotheses were adopted in the paper:

- Knowledge of natural feeding does not depend on the number of births.
- Knowledge of natural feeding depends on social and demographic factors.
- Pregnant women are most afraid of pain/cracking of warts.
- Most of the women surveyed know how lactation should be stimulated.
- Women get information about natural feeding from the family.

Materials and methods

The survey was conducted between April and May 2019 among 102 pregnant women. To obtain the results, an original questionnaire was used using the diagnostic survey method. The questionnaire was made available to the subjects via e-mail and social media, and in the case of some of the respondents in the form of physical sheets delivered to the subjects' own hands. The survey used in the study consisted of six imprint questions and nineteen specific questions in the form of seventeen closed questions and two semi-open questions. The level of knowledge of pregnant women about breastfeeding was determined by creating a new variable, which consisted in assessing the correct or wrong answers contained in the questionnaire. In the case of a correct answer, one point was awarded, while when an incorrect answer was given, the person did not get a point. Then the points were counted and converted into percentages. The number 100% meant that all answers were correct. In order to determine the knowledge, percentage ranges were used, on the basis of which it was determined whether the studied group had knowledge at a low, medium or high level. The work assumes that people who answered the questions correctly up to 65% have low-level knowledge, while correct answers in the range of 66 –75% will indicate an average level of knowledge, and a high one, when the studied group answers questions well in the range of 76– 100%. The obtained result was subjected to statistical analysis using tests based on the chi-squared distribution ($\chi 2$). The choice of the test was

dictated by the nature of the variables participating in the analyses. In each case, these were qualitative variables (measured at the nominal or ordinal level). In addition, the analysis used the chi-square test (χ^2) for one sample, which consists in comparing the proportions of answers given to one question, referred to in the above analysis as a variable. With the help of the above test, a comparative analysis of the observed and expected values is carried out. In the case of giving the same answers to a given question, the proportion of the distribution of answers would be one, then we have in mind the expected values. The calculations were performed in statistical environment R version 3.5.5, PSPP and Microsoft Office. The significance level was $p = 0.05$. The results $p < 0.05$ indicated the occurrence of statistically significant relationships between the studied variables.

Results

Sociodemographic indicators in the group of women studied

The research group consisted of women aged 26-35 years (46.10% - 47 women). The second largest group were women representing the age range up to 25 years of age - they accounted for 30.40% (31 women) of the respondents. In the 36-45 age range, 22 women (21.60%) responded. The least numerous group of respondents were women over 45 years of age - they accounted for 1.90% of the total respondents (2 women). Most of the respondents were in an informal relationship. This answer was given by 46.10% of women (47 people). Married women constituted 20.60% of all respondents (21 people), virgins 17.60% (18 people), divorced 12.70% (13 people), and widows 2.90% (3 people). Almost half of the respondents – 48.00% (49 women) – had had one birth, 32.40% (33 people) were pregnant for the first time, 11.80% (12 people) had given two births, and 7.80% (8 people) had three or more births. The vast majority of respondents lived in the city. This was indicated by 67.60% of women (69 people). 32.40% (33 women) lived in the countryside. 40.20% of respondents (41 people), 27.50% higher education (28 people), 25.50% secondary/post-secondary education (26 people), and 6.90% primary education. Almost half of the women surveyed reported that their economic situation is good. This was indicated by 47% (48 people). The economic situation was declared by 28% (29 women), and the average by 25% (25 people). None of the ladies said that her situation was bad.

Pregnant women's knowledge of breastfeeding

Respondents had knowledge of breastfeeding at a medium level (Table 1) - 73.06 %.

Tab. 1 Level of knowledge about breastfeeding – descriptive statistics of the study group

	N	*M*	*SD*	*Min*	*Max*	*Me*
Knowledge points	102	26,32	2,12	20,00	31,00	26,00
Knowledge %	102	73,06	5,92	56,00	86,00	72,00

N – abundance; *M* – average; *SD* – standard deviation; *Min* – minimum; *Maximum* – maximum; *Me* – median

The vast majority of women surveyed – 57.80% (59 women) – considered their knowledge about breastfeeding to be very high, 28.40% (29 people) indicated a lack of knowledge, 10.80% (11 people) rated their knowledge as average, and 2.90% (3 ladies) as very low. The actual level of knowledge of the women was assessed using a new variable created for the purpose of analysis. On its basis, it should be noted that 8.8% (9) of the surveyed women have a low level of knowledge in the studied group, 459.8% (61 women) presented an average level of knowledge, and a high level – 31.4% (32 women) - Figure 1.

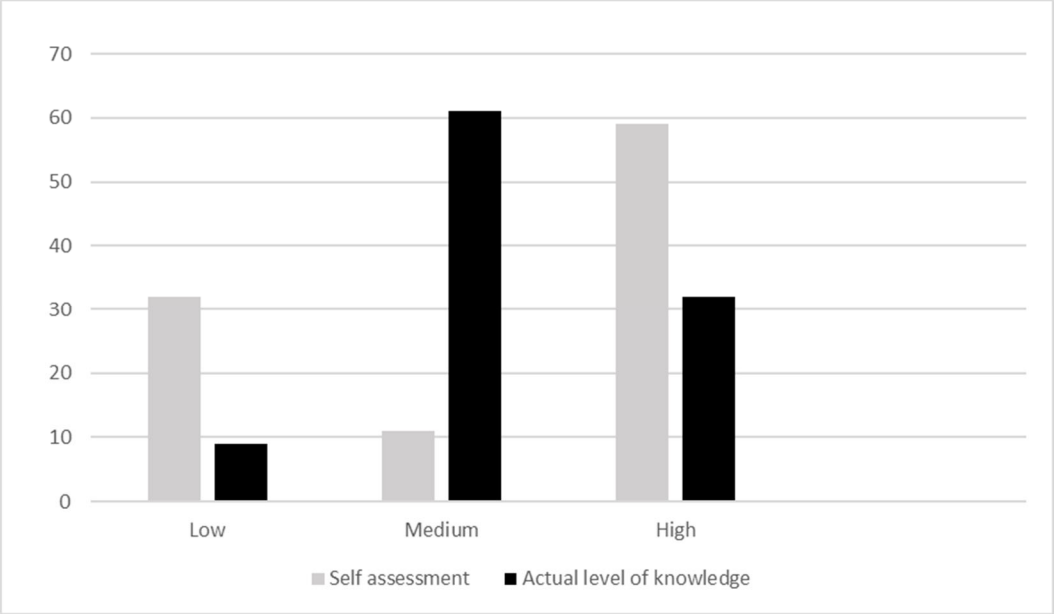

Fig. 1. Subjective and real knowledge of pregnant women about breastfeeding

Pregnant women's knowledge of the benefits of breastfeeding

Emotional bond

The majority of respondents were of the opinion that natural feeding strengthens the emotional bond between mother and child. This was indicated by 85.30% of respondents (87 people). According to 8.80% (9 people) rather strengthens, and 5.90% (6 people) do not know if it strengthens. None of the respondents answered that natural feeding is unlikely to strengthen or definitely strengthen such a bond.

Intellectual development of the child

Most of the respondents considered that natural feeding definitely affects the intellectual development of the baby. This was indicated by 64.70% of women (66 people). Rather, 22.50% (23 people) considered it, 11.80% (12 people) are unlikely to influence. One percent of the pregnant women surveyed (1 lady) did not know whether it was influencing or not.

Prevention of diseases in mother and child

The majority of respondents – 63.704% (65 people) – said that natural feeding significantly reduces the risk of breast cancer in the mother. Rather, 28.40% (29 women) considered it decreased, 2.90% (3 people) claimed not to decrease, and 4.90% (5 people) did not have such knowledge. The majority of respondents – 62.70% (64 people) – believed that natural feeding significantly reduces the risk of ovarian cancer in the mother, 24.50% (25 people) that it rather decreases, 2.90% (3 people) that it does not decrease, and 9.80% (10 people) did not have such knowledge. According to 32.40% of respondents (33 people), natural feeding definitely does not reduce the risk of osteoporosis in the mother, according to 20.60% (21 people) it definitely decreases. According to 16.70% (17 people) rather decreases, and according to 4.90% (i.e. 5 people) rather not. Twenty-six respondents (25.50%) had no knowledge of the subject.

The majority of respondents – 52.90% (i.e. 54 people) – considered that natural feeding significantly reduces the risk of obesity in the child. According to 30.40% (31 people) rather decreases, 3.90% (4 people) rather does not decrease, 2.00% (2 people) definitely does not decrease, and 10.80% (11 people) did not have such knowledge. According to 51.00% of respondents (52 people), natural feeding definitely prevents the occurrence of cancer in the child. According to 37.30% (38 people) it rather prevents, and according to 8.80% (9 people) it is unlikely to prevent. Three people – 2.90% of all respondents – did not know whether natural feeding prevents the occurrence of cancer in the baby. The majority of respondents – 57.80% (59 people) – believed that natural feeding significantly reduces the risk of respiratory diseases in the baby. According to 37.30% (38 people) rather reduces the risk, and according to 1.00% (1 person) does not reduce the risk. Four respondents (3.90%) did not know whether it was reducing or not.

Pregnant women's knowledge of the World Health Organization's recommendations on breastfeeding

The women surveyed answered the minimum period of feeding the baby recommended by the World Health Organization. The answers were as follows: 42.20% (43 people) – six months, 28.40% (29 people) – one year, 16.70% (17 people) – three months, 6.90% (7 people) – over 1 year, and 5.90% (6 people) did not know. The majority of respondents – 57.80% (59 people) – said that breastfeeding should be started within two hours after delivery. According to 20.60% (21 people) during the day, and according to 9.80% (10 people) within six hours. Twelve people (11.80%) did not know when to start feeding after giving birth.

Breastfeeding after childbirth

Natural feeding or artificial mixtures

The vast majority of respondents – 87.30% (89 people) – declared only natural feeding after giving birth. Natural feeding and artificial mixtures declared 7.80% (8 individuals), only artificial mixtures 2.90% (3 individuals), although 2.00% (2 people) did not yet know what this feeding would be.

Position during breastfeeding and correct latching of the baby to the breast

All respondents (100.00%) knew that the classic and lying positions during feeding the baby are normal. The vast majority of respondents also considered the lying position (76.47%, 78 people) and the cross position 52.94% (54 people) to be correct. Only 22.55% (23 people) knew the armpit position. Each of the above-mentioned items was considered correct by a total of 76.47% of respondents (78 people). Then, the women were asked to answer what characteristics indicate the correct attachment of the baby to the breast. The answers were distributed as follows: 100% mentioned the stably arranged head and neck by the child and the fact that the baby's mouth is located directly on the mother's nipples; 98.04% indicated a straight child's spine; 97.06% that the child grabs the entire nipple areola with his mouth, and 76.47% that sucking does not cause pain to the woman.

Women's concerns during breastfeeding and sources of knowledge about natural feeding

The vast majority of respondents were most afraid or afraid during breastfeeding that they would be tired mentally and physically. This was indicated by 95.10% of respondents. Also, a large percentage of women – 87.25% – mentioned sleepless nights. Other concerns of pregnant women were as follows: mandatory diet 79.41%; I will not be able to leave the house for longer

due to feeding the baby – 54.90%; I will neglect the older child – 40.20%; pain/cracking of warts – 33.33%; problem with assessing whether the baby is full – 31.37%; whether the baby is latched to the breast in the correct way – 20.59 %; that the child will eat too long – 9.80%; I will not be attractive to my partner/husband – 7.84%; feeding the baby in front of strangers – 2.94%. In contrast, 4.9% were not afraid of anything or are not afraid.

The women were asked where they got their information about breastfeeding. The answers were as follows: from the family (e.g. mother, sister, aunt, etc.) 91.18%; from the pharmacist 90.20%; from the Internet 89.22%; from the midwife 76.47%; from a nurse 65.69%; from women's magazines 51.96%; from the school of childbirth 27.45%; from specialized literature 20.59%; from the doctor 13.73%. Due to the fact that data on knowledge sources were obtained in the form of a multiple question, a new variable was created for the test, containing two categories of answers: *family* and *another answer*. The family is a source of knowledge about natural feeding for 91.2% of the women surveyed, only 8.8% indicated a different answer. Significantly more often the women studied drew knowledge about natural feeding from the family than from other sources. Statistically significant results were obtained ($p < 0.05$) – Table 2.

Tab. 2 Women's concerns during breastfeeding and sources of knowledge about natural feeding

Variable level	Values	N	Proportion	Rest	Test result
Pain/cracking of warts	Observed	34,00	0,333	17,00	*x2* = 11,33
	Expected	51,00	0,500		*df* = 1
Another answer	Observed	68,00	0,667	-17,00	*P* = 0,001
	Expected	51,00	0,500		
Another answer	Observed	9,00	0,088	42,00	*x2* = 69,18
	Expected	51,00	0,500		*df= 1*
Family	Observed	93,00	0,912	-42,00	*p=0,001*
	Expected	51,00	0,500		

χ2 - test statistics; df – degrees of freedom; N - abundance; p - significance

Ways to stimulate lactation and food storage conditions

According to the vast majority of women surveyed – 97.06% – lactation can be stimulated by drinking more fluids. According to 69.61%, the baby should be latched to the breast more often; according to 58.82% express milk; according to 56.86% change the feeding technique. Only 2.94% did not know how to stimulate lactation. The women were also asked how and under what conditions breast milk could be stored. Most women – 63.73% – indicated that food can be stored at room temperature (up to a maximum of 25°C) optimally for 4 hours, up to a

maximum of 8 hours. After 59.80% mentioned that it can be stored in a bag-refrigerator – up to a maximum of 24 hours and in the refrigerator – up to a maximum of 96 hours. The possibility of storing food in the freezer for up to two weeks was indicated by 51.96% of women, and in the freezer from 3 to 6 months by 20.59% of respondents. How and for how long women's food can be stored was not known by 28.43% of the respondents.

Nutrition of breastfeeding women

Respondents were asked how often and what products should be consumed during the natural feeding period. The answers were as follows: meals at least three times a day 100%; meals varied and fresh 100%; easily digestible meals 100%; vegetables, except such as: peas, beans, cabbage, garlic, onions 99.02%; protein products of vegetable and animal origin 98.04%; cereal products 97.06%; water, fruit teas 95.10%; in a small amount vegetable and animal fats 95.10%; weak coffee and tea 85.29%; citrus, strawberries, cocoa, chocolate 7.84%; fatty cold cuts, sausages, meats, yellow cheeses, fried dishes 1.96%; strong coffee and tea 0.98% and such vegetables as: peas, beans, cabbage, garlic, onions 0.98%.

The level of knowledge of pregnant women about breastfeeding depending on sociodemographic factors and the number of births

The data obtained show that a low level of knowledge was presented by 9.7% of women from the group up to 25 years of age, 6.4% from the group of 26-35 years and 12.5% from the group over 35 years. In turn, 25.8% of pregnant women from the group up to 25 years of age, 29.8% from the group of 26-35 years and 41.7% from the group over 35 years of age stood out at a high level. The responses did not allow to indicate significant differences, and therefore it cannot be considered that there is a close correlation between the age of pregnant women and the level of their knowledge related to the benefits of natural feeding. The result of the test ($p > 0.05$) is not statistically significant. 8.3% of women with vocational or primary education, 7.7% with secondary or post-secondary education and 10.7% with higher education had a low level of knowledge about natural feeding. On the other hand, 31.3% of women with vocational education or lower, 34.6% of secondary/ post-secondary education and 28.6% – higher education presented a high level of knowledge. No statistically significant differences were observed. The hypothesis has therefore not been confirmed. Due to the small numbers of the original categories, they were merged and a variable was created, having two categories: *In a relationship* and *Not in a relationship*. The data show that 5.9% of women from the group who are not in a relationship and 10.3% from the group in a relationship stood out with a low level of knowledge. On the other hand, 38.2% of pregnant women from the group who are not in a

relationship and 27.9% from the group in a relationship stood out with a high level of knowledge. Since the differences should not be considered statistically significant, the assumption has not been positively verified. It should be pointed out that 6.9% of respondents from the group had a low level of knowledge in a very good economic situation, 8.3% in a group in a good economic situation and 12% in an average economic situation group. A high level of knowledge was presented by 37.9% of the group very economic situation good, 29.2% of the group "economic situation good and 28% of the group economic situation average. On this basis, it can be concluded that the assumption made has not been confirmed. The data obtained show that it is not statistically significant. 6.1% of women in the group had a first pregnancy, 4.1% of the group had one birth and 25% had two or more births stood out with a low level of knowledge. On the other hand, 33.3% of women from the group with the first pregnancy, 34.7% of the group had one birth and 20% had two or more births stood out with a high level of knowledge. Thus, there was no relationship between the level of knowledge of pregnant women about breastfeeding and the number of births. The assumption that has been made is to be considered unconfirmed (Table 3).

Tab. 3 The level of knowledge of pregnant women about breastfeeding depending on sociodemographic factors and the number of births

Level of knowledge depending on the age of the respondents						
			Age			Test result
			Up to 25 years	26-35 years	Over 35 years old	
Level of knowledge	Low	N	3	3	3	x^2 = 2,891 df = 4 p = 0,576
		%	9,7%	6,4%	12,5%	
	Medium	N	20	30	11	
		%	64,5%	63,8%	45,8%	
	High	N	8	14	10	
		%	25,8%	29,8%	41,7%	
Total		N	31	47	24	
		%	100%	100%	100%	
Level of knowledge depending on education						
				Education		Test result
			Basic/ Professional	Medium/ post-secondary	Higher	
Level of knowledge	Low	N	4	2	2	χ^2 = 0,34 8df = 4 p = 0,987
		%	8,3%	7,7%	10,7%	
	Medium	N	29	15	17	
		%	60,4%	57,7%	60,7%	
	High	N	15	9	8	
		%	31,3%	34,6%	28,6%	
Total		N	48	26	28	

		%	100,0%	100,0%	100,0%	
Level of knowledge depending on marital status						
			Marital status			Test result
			Unrelated		In a relationship	
Level of knowledge	Low	N	2		7	$\chi^2 = 1,397$ $df = 2$ $p = 0,497$
		%	5,9%		10,3%	
	Medium	N	19		42	
		%	55,9%		61,8%	
	High	N	13		19	
		%	38,2%		27,9%	
Total		N	34		68	
		%	100%		100%	
The level of knowledge and the economic situation						
				Economic situation		Test result
			Very good	Endorsement	Average	
Level of knowledge	Low	N	2	4	3	$\chi^2 = 1,146$ $df = 4$ $p = 0,887$
		%	6,9%	8,3%	12,0%	
	Medium	N	16	30	15	
		%	55,2%	62,5%	60,0%	
	High	N	11	14	7	
		%	37,9%	29,2%	28,0%	
Total		N	29	48	25	
		%	100,0%	100,0%	100,0%	
Level of knowledge and number of births						
				Number of births		Test result
			Did not give birth/first pregnancy	Every	Two or more	
Level of knowledge	Low	N	2	2	5	$\chi^2 = 8,600$ $df = 4$ $p = 0,072$
		%	6,1%	4,1%	25,0%	
	Medium	N	20	30	11	
		%	60,6%	61,2%	55,0%	
	High	N	11	17	4	
		%	33,3%	34,7%	20,0%	
Total		N	33	49	20	
		%	100,0%	100,0%	100,0%	
χ^2 = test statistics; df = degrees of freedom; N - abundance; p = statistical significance						

Dependence of pregnant women's knowledge on the storage conditions of expressed breast milk on the age of respondents

The result of the test ($p > 0.05$) is not statistically significant (Table 4). 29% of women up to 25 years of age, 27.7% of women aged 26-35 and 29.2% over 35 years of age had no knowledge

of food storage. The differences are not statistically significant and therefore the assumption has not been confirmed.

Tab. 4 The relationship between women's age and their knowledge of storing expressed milk

			Age			Test result
			Up to 25 years	26-35 years	Over 35 years old	
Store	I do not know	N	9	13	7	$\chi^2 = 0{,}026 df = 2$ $p = 0$
		%	29,0%	27,7%	29,2%	
	Another answer	N	22	34	17	
		%	71,0%	72,3%	70,8%	
Total		N	31	47	24	
		%	100,0%	100,0%	100,0%	
X^2 - test statistics; df - degrees of freedom; N - abundance; p - significance						

Breastfeeding and prevention of nursing women

The work assumes that the vast majority of women are aware of the importance of natural feeding in the prevention of diseases such as breast cancer, ovarian cancer and osteoporosis. It should be emphasized that as many as 92.2% of respondents are aware that natural feeding reduces the risk of breast cancer in the mother. The assumption made must therefore be regarded as confirmed. The above statistics show that 87.3% of respondents were aware that natural feeding reduces the risk of ovarian cancer in the mother. In this case, the assumption was confirmed. Only 37.3% of women surveyed are aware that natural feeding can significantly reduce their risk of osteoporosis, 32.4% are definitely unaware and 4.9% are rather unaware. The assumption has therefore not been confirmed in this respect (Table 5). Statistically significant results were obtained ($p < 0.05$).

Tab. 5 Difference in observed and expected values – breast cancer, ovarian cancer and osteoporosis

Observed (actual) and expected values – breast cancer					
Variable level	Values	N	Proportion	Rest	Test result
Yes	Observed	94,00	0,922	-60,00	$\chi^2 = 158{,}88$ $df = 2$ $p = 0{,}001$
	Expected	34,00	0,333		
Rather	Observed	3,00	0,029	31,00	
	Expected	34,00	0,333		
I do not know	Observed	5,00	0,049	29,00	
	Expected	34,00	0,333		

Observed (actual) and expected values – ovarian cancer					
Variable level	Values	N	Proportion	Rest	Test result
Yes	Observed	89,00	0,873	-55,00	$\chi^2 = 134,18$ $df = 2$ $p = 0,001$
	Expected	34,00	0,333		
Rather not	Observed	3,00	0,029	31,00	
	Expected	34,00	0,333		
I do not know	Observed	10,00	0,098	24,00	
	Expected	34,00	0,333		
Difference in observed and expected values – osteoporosis					
Variable level	Values	N	Proportion	Rest	*Test result*
Yes	Observed	38,00	0,373	-12,50	$\chi^2 = 24,82$ $df = 3$ $p = 0,001$
	Expected	25,50	0,250		
Definitely not	Observed	33,00	0,324	-7,50	
	Expected	25,50	0,250		
Rather not	Observed	5,00	0,049	20,50	
	Expected	25,50	0,250		
I do not know	Observed	26	0,255	-0,50	
	Expected	25,50	0,250		
X^2 - test statistics; df - degrees of freedom; N - abundance; p - significance					

Discussion

Summarizing the results, it should be stated that the respondents generally show good knowledge about natural feeding. Women who have already given birth have slightly more knowledge than women who have never given birth, but they also mention greater concerns due to previous experiences related to feeding. The author's study identifies family members (91.2%), a pharmacist (90.2%) and the Internet (89.2%) as the main sources of information about breastfeeding. Women were less likely to receive knowledge from health care representatives in Poland – 76.5% of respondents obtained information from a midwife, 65.7% from a nurse, and only 13.7% from a doctor. A study conducted in Tanzania (Hashim 2017) indicates health care as the main source of knowledge about breastfeeding for pregnant women. The share of family members and the media was much smaller than the author's study showed and accounted for 30% and 36%, respectively. The obtained results indicate an insufficient level of information provided by health care representatives in Poland, in particular by

pediatricians and gynecologists. The author's study does not indicate the influence of sociodemographic factors on the level of knowledge about breastfeeding. One of the factors studied was the influence of the degree of education on the level of knowledge about feeding. The study did not show a favorable correlation between higher education and the level of knowledge about breastfeeding. Different results were obtained by Abebe et al. (2022), which show that as the level of education increased, the level of knowledge about breastfeeding increased. People attending college showed twice and attending university as much as three times higher level of knowledge compared to people without any formal education. The study indicates a high level of knowledge of pregnant women about breastfeeding. More than 90% of the women surveyed have a high and medium level of knowledge. It follows that pregnant women are interested in the subject of breastfeeding and obtain knowledge on this subject from various sources. A study conducted on the population of pregnant women in Jordan Kwasawneh et al. (2020), in which 78% of respondents obtained a good result on the benefits of breastfeeding and WHO recommendations, leads to similar conclusions. Similar results (Carmen Suárez-Cotelo 2019) were obtained by conducting a study on the female population in Spain and Galicia, where more than 80% of respondents obtained an adequate level of knowledge. The differences between the studies are manifested in the level of women's knowledge about the World Health Organization's recommendations regarding the recommended length of breastfeeding – in the author's study, only 42.2% of respondents gave the correct answer. The study shows no correlation between sociodemographic factors and the level of knowledge about the recommended length of breastfeeding. A study conducted on the population of women after childbirth in Poland (Dzbuk 2016), according to which the indicators supporting a higher level of knowledge about breastfeeding were, m.in, having a higher education, having two children, leads to different conclusions. The results of this study also coincide with the results of the author's study, without showing a statistical relationship between knowledge of the WHO recommendations regarding the shortest time in which one should exclusively breastfeed between age, place of residence, socioeconomic status and marital status.

Conclusion

Breastfeeding is a key element in providing your newborn with a proper diet. For this reason, ensuring an adequate level of knowledge about it is a fundamental link in the proper nutrition of children. The study indicates a high level of knowledge of pregnant women about the positive aspects of this way of feeding. The vast majority of women surveyed were aware of the benefits for the child of a diet based on breast milk. Slightly smaller, but still high, women also showed a high level of knowledge about the benefits for the mother during breastfeeding. Most of the

women were aware of the long-term effects of breastfeeding in terms of building a bond with the baby, increasing the child's intelligence level and reducing the risk of obesity and diabetes in adulthood. The study did not indicate the impact of sociodemographic conditions such as age, place of residence, education or the number of births on the level of knowledge among the women surveyed. Most of the respondents indicated family members as the main source of knowledge about breastfeeding. The most popular sources of knowledge were also the Internet and knowledge obtained through a pharmacist in a pharmacy. Worryingly, only a small fraction of the respondents obtained information from doctors conducting pregnancy. Despite the high general level of knowledge about breastfeeding, there is a group of women with an insufficient degree of it, so educational programs for pregnant women should be carried out and the degree of knowledge transfer by specialist doctors should be increased.

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PREVENTION METHODS AND THE ROLE OF MEDICAL PERSONNEL IN PREVENTING SURGICAL SITE INFECTIONS

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Abstract

Surgical site infection (SSI) is associated with surgical intervention and tissue disruption. These infections affect patients all over the world, are severely affected by patients' health and contribute to higher treatment costs. Infection can be superficial or deep cuts in organs or body cavities. The correct assessment of the risk of surgical site infection is not based solely on the degree of cleanliness of the wound. Patient-related risk factors (age, nutritional status, addictions, impaired immune response, carrier of microorganisms), the operating room environment, the surgical procedure and its technique, as well as factors related to the underlying disease and comorbidities contribute to the development of SSIs. with the number and virulence of microorganisms. Surgical site infections are caused by bacteria, viruses, parasites or fungi. The main etiological factor in exogenous infections is *Staphylococcus aureus*, including in particular *methicillin-resistant strains - MRSA*, the main source of which are carriers among medical personnel and other patients. Other factors of exogenous infections include: *Staphylococcus aureus* strains producing *septic shock toxin (TSS), Streptococcus pyogenes*, *Clostridium perfringens*, *Vancomycin-Resistant Enterococci (VRE),* as well as multiresistant strains of Gram-negative bacilli. During the surgical cutting procedure, the natural physiological barrier is damaged, which results in the penetration of microorganisms into deeper tissues and its contamination. Surgical site infections are mainly caused by pathogens of endogenous origin on the skin or from the environment of the operated organs. The basic method of preventing SSI is the awareness of the medical staff and the patient

himself. Compliance with the rules of hygiene, adherence to and creation of new procedures and standards that relate to safe and effective conduct during surgical procedures.

Keywords: microorganisms, methods of prevention SSI, surgical site infections, skin breakdown

Introduction

It is now recognized that surgical site infection occurs 30 to 90 days after surgery and develops at the incision site or in the deep tissues of the operated site. With the advancement of medicine, the incidence of post-surgical infections has decreased, but they are still a significant problem to this day [Leaper and Ousey,2015]. It is important to properly prepare the patient for the procedure in violation of tissue continuity, to use aseptic practice and to pay attention to surgical techniques [Montewka et al., 2012].

Surgical site infection (SSI) is always associated with surgical intervention and tissue disruption. These infections affect patients all over the world and are quite serious. The ongoing advances in medicine, including access to more and more modern technologies, as well as the increase in the qualifications of medical personnel result in an increase in the number of surgical procedures performed [Fernandez-Prada et al., 2017]. Therefore, it is extremely difficult to avoid adverse events, which include infection of the operated site. Therefore, taking into account the health effects of patients and the costs of treatment of complications, research is carried out around the world, analysis of the causes of infection, the type of bacteria and sources of infection, as well as the sources and factors of infection, and the search for methods that would reduce the number of infections [Jolivet and Lucet, 2019].

Division of surgical site infections

The term "surgical site infection" was introduced in 1992, replacing the earlier nomenclature "surgical wound infection". The term SSI (surgical site infection SSI) was introduced by the US Center for Diseases Control and Prevention (CDC). at the incision site or in deep tissue at the site of surgery. The infection may be superficial or involve a deep cut, organ or cavity [Lefebvre et al., 2015].

The definition and diagnosis of the form of infection is based on criteria that help identify SSIs based on CDC recommendations and can be divided into [Phelan et al., 2020]:

Superficial **-** they develop up to 30 days after the surgery and include the skin and subcutaneous tissue.

Deep - develop up to 30 days or one year if a foreign body has been implanted in the operated area. Inflammation affects deeper soft tissues in the area of the incision - fascia, muscles.
Infections of an organ or body cavity in direct contact with the operated site - develop up to 30 days or one year if a foreign body has been implanted in the operated area.
Therefore, it is important to understand the criteria for the correct diagnosis of surgical site infection.

Risk factors

Surgical wounds are divided into IV levels of microbiological purity according to the CDC definition [Kolasiński and Pomorski, 2020]:

Grade I: *clean wound* - risk of infection <2%, eg after opening the abdominal cavity, breast amputation, vascular procedures

Grade II: *clean contaminated wound* - risk of infection <10%, eg elective cholecystectomy, resection of the small intestine, laryngeal resection

Grade III: *contaminated wound* - infection risk of about 20%, eg pyoderma appendicitis, gangrenous cholecystitis

Grade IV: *dirty infected wound* - risk of infection> 40%, infected traumatic wounds, contamination of the operating field as a result of perforation of the cavernous organ or organ necrosis, wounds with an active purulent process, eg testicular abscess

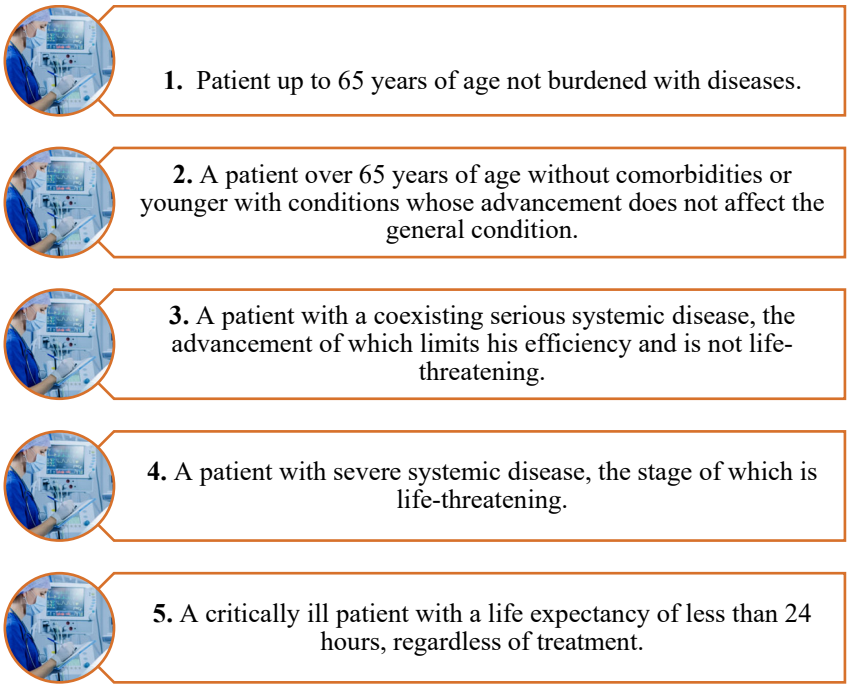
The correct assessment of the risk of surgical site infection is not based only on the degree of cleanliness of the wound. Risk factors related to the patient, the operating room environment, the surgical procedure and its technique as well as factors related to the underlying disease and coexisting diseases, as well as the number and virulence of microorganisms contribute to the development of SSI [Shi et al. 2017].

Patient-related factors that increase the risk of SSI [Siczyńska et al., 2014; Kothari et al., 2016]:

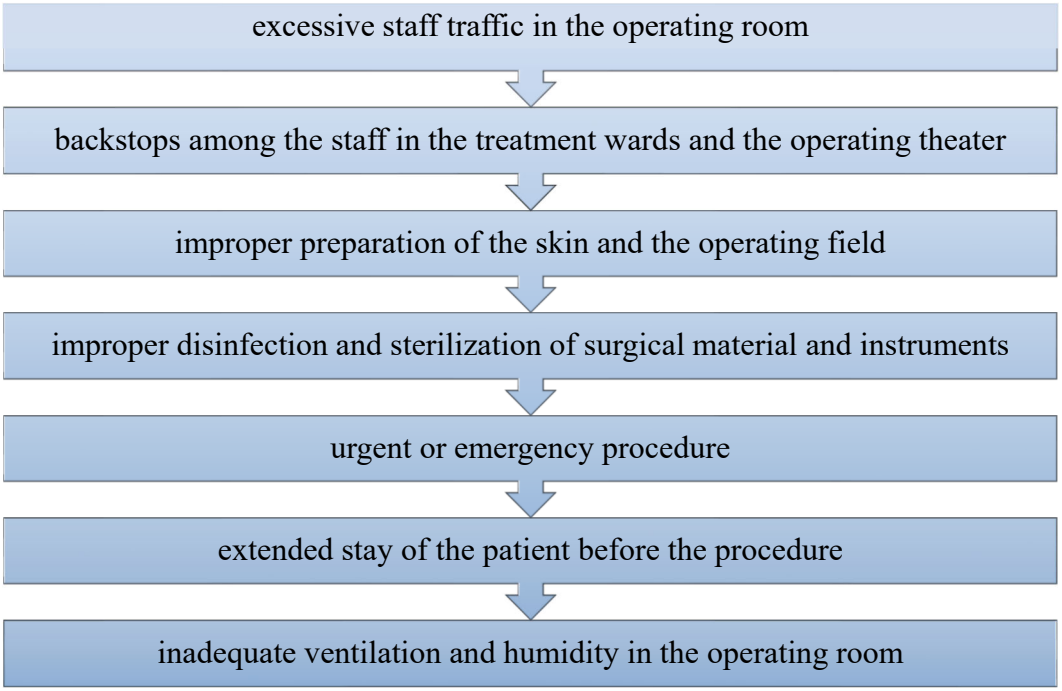
- patient's age - after the age of 75, the risk of SSI is above 11% - with age the immunity gradually deteriorates,
- nutritional status: obesity, overweight, body mass index over 30 or malnutrition, cachexia,
- haemorrhage and shock,
- accompanying diseases - diabetes mellitus, liver cirrhosis, jaundice, renal failure with uremia, obstructive pulmonary diseases, circulatory and respiratory failure,
- smoking,
- coexisting infections - urinary tract infections or infections of the skin and subcutaneous tissue distant from the operated site,
- disorders of the immune response - the use of immunosuppressants, cytostatics, ionizing radiation,
- carrier of microorganisms.

Patient-related risk factors determine the general condition of the patient and at the same time their susceptibility to possible infection. The general condition of the patient is normally described using the ASA index, which is a five-step pre-operative classification of the patient's condition performed by an anesthesiologist [Weibel et al., 2020].

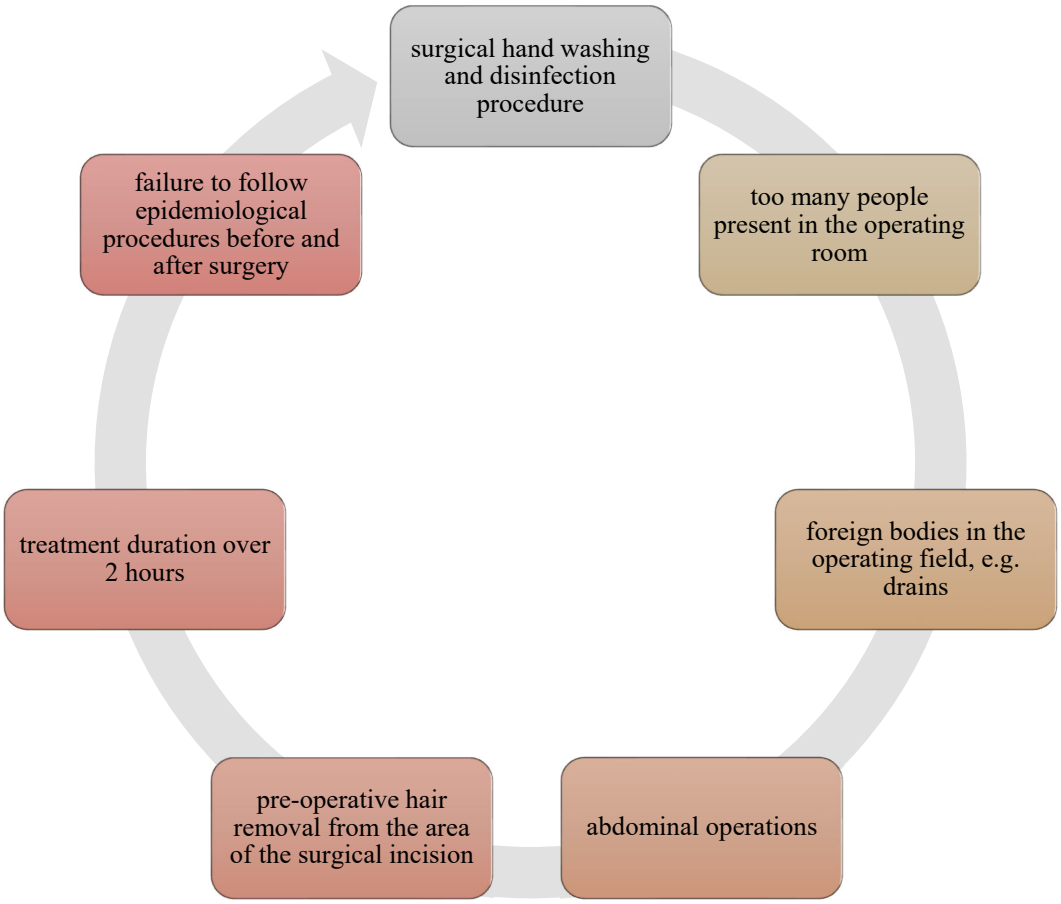
ASA scale [Vasiliu et al., 2015; Kilic et al., 2021]:



Environmental-related factors that increase the risk of SSI [Fang et al., 2017; Alkaaki et al., 2019]



Risk factors increasing the risk of SSIs associated with a surgical procedure [Gomaa et al., 2021]

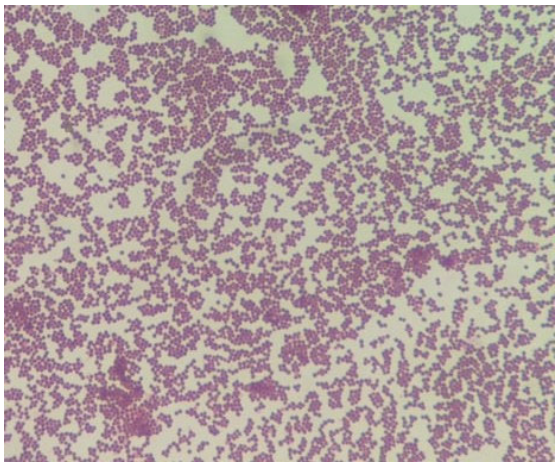


Etiological factors of surgical site infections

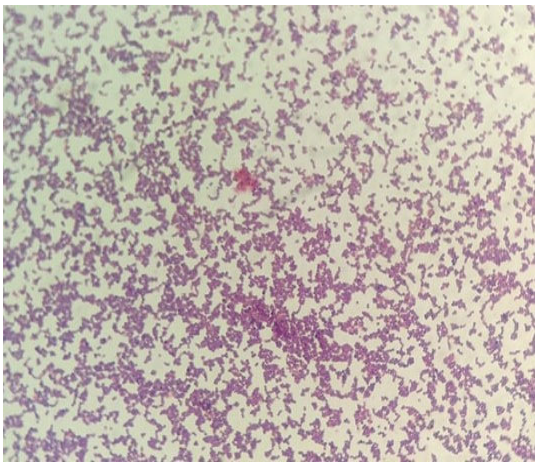
Infection is understood as the penetration, multiplication and development in a living organism of a biological pathogen, which are bacteria, viruses, parasites or fungi. The skin is the largest organ in the human body, colonized by a diverse environment of microorganisms, most of which are harmless and even beneficial to the host [Cheng et al., 2017]. Its colonization is highly variable and depends on the topographic location, endogenous host factors and exogenous environmental factors. The primary function of the skin - the physical barrier - is to protect the body from potential attack by harmful microorganisms [Xu et al., 2020]. During the surgical cutting procedure, the natural physiological barrier is damaged, which results in the penetration of microorganisms into deeper tissues and its contamination. Surgical site infections are mainly caused by pathogens of endogenous origin on the skin or from the environment of the operated organs [Kocuret al., 2021].

Surgical site infection may also be caused by bacteria of exogenous origin, the reservoir of which may be other patients, medical personnel, and the hospital environment [Freireet al., 2021]. The main etiological factor in exogenous infections is *Staphylococcus aureus*, including in particular *methicillin-resistant strains - MRSA*, the main source of which are carriers among medical personnel and other patients [Owens and Stoessel, 2008]. Other factors of exogenous infections include: *Staphylococcus aureus* strains producing septic shock toxin (TSS), *Streptococcus pyogenes, Clostridium perfringens*, *Vancomycin-Resistant Enterococci*, as well as multiresistant strains of Gram-negative bacilli [Tamura et al., 2004; Oh et al., 2021; Nagy et al., 2022].

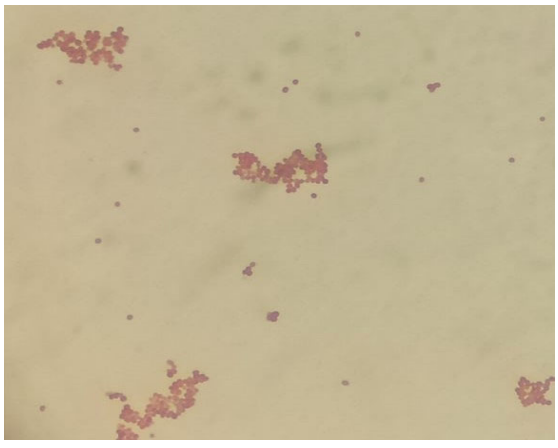
The microscopic images of pathogens causing the most common infection of the operated site are presented in Figure 1.



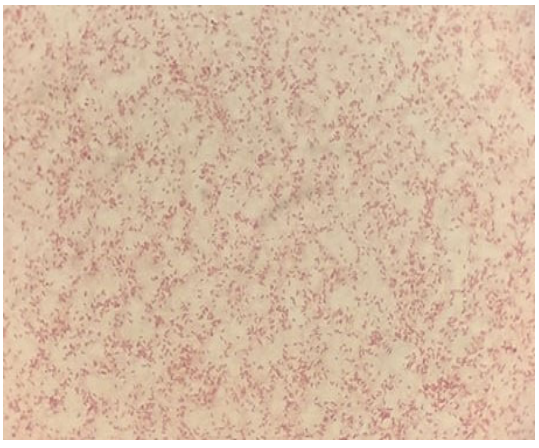
Staphylococcus epidermidis *[own study]*



Staphylococcus aureus *[own study]*

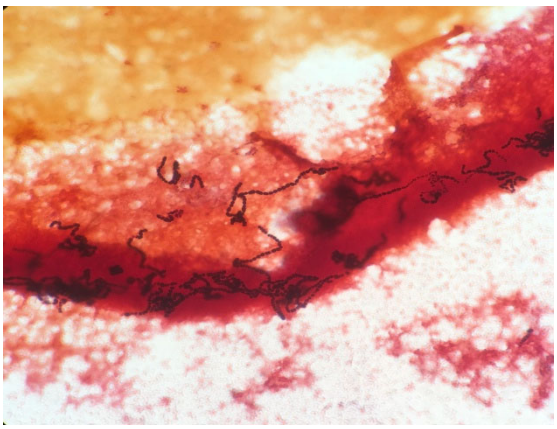


Acinetobacter baumannii *[own study]*

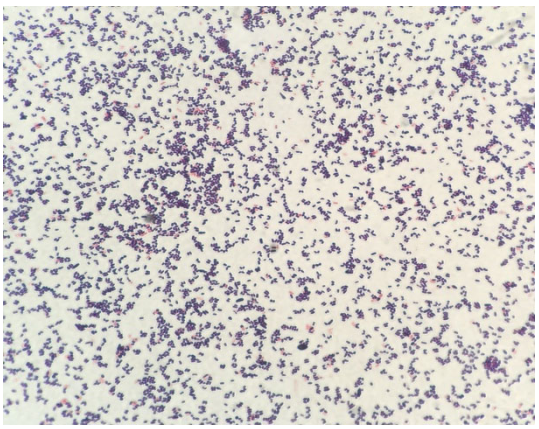


Pseudomonas aeruginosa *[own study]*

Fig. 1



Streptococcus pyogenes*[own study]*



Corynebacterium species *[own study]*

Fig. 1 The most common pathogens causing surgical site infections [Gram staining, magnification 1000x, own archive]

Methods and role of medical personnel in preventing surgical site infections

The basis for the success of a patient avoiding SSIs is the awareness of the medical staff and the patient himself. Compliance with the rules of hygiene, adherence to and creation of new procedures and standards that provide for safe and effective procedures [Ling et al., 2019].

Preparation of medical personnel's hands to work

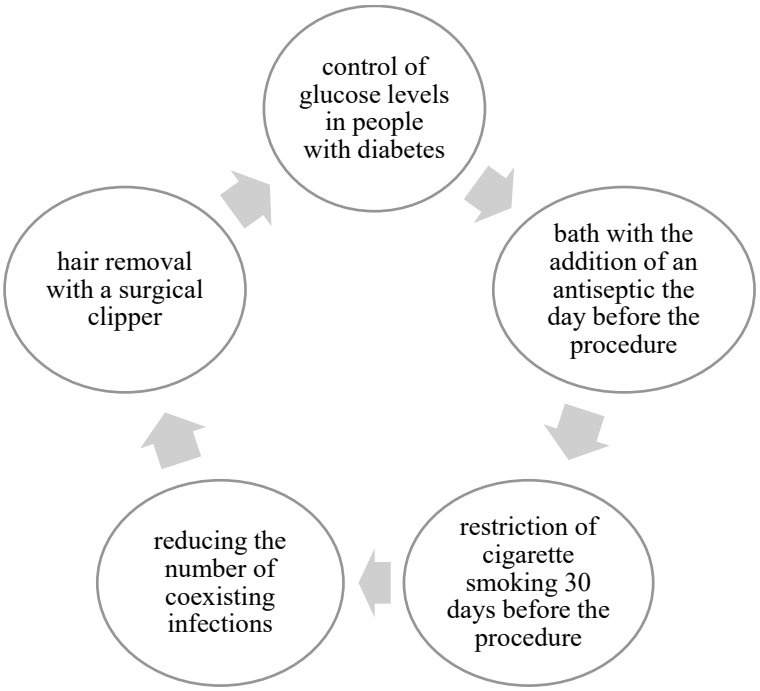
Washing and disinfecting hands is the most effective method of infection prevention. It applies to all healthcare professionals, regardless of their work [Alverdy et al., 2020].

Medical personnel implement hand hygiene in practice by [Goldberg, 2017]:

- use of the 6-step technique of hand hygiene
- the rules of the 5 moments of hand hygiene
- use of protective gloves
- avoiding wearing anything below the elbow
- wearing surgical blouses with short sleeves
- wearing short natural nails
- removing the jewelry, as the skin underneath it may harbor microorganisms
- securing any skin damage with a dressing

Pre-operative management

It includes three main components: patient preparation, staff preparation and antibiotic prophylaxis, and aims to reduce as many patient-dependent risk factors as possible [Brambrink et al., 2013; Kothariet al., 2016; El-Hussuna et al., 2017; Fernandez-Prada et a., 2017]:



The next stage is the preparation of the operating field [Ozturk et al., 2022]:

- disinfection of the operating field with antiseptic preparations and performed concentrically, several times, evenly and allowed to dry,
- the disinfected surface should be larger than the planned cut,
- the operating field should be covered with sterile napkins and self-adhesive edges,
- the use of self-adhesive films,
- use of antibacterial sutures,
- use of drainage

Preparation of the operational team [Dockery et al., 2021; O'Hara et al. 2018]:

- proper decontamination of the hands, hands and forearms,
- removing jewelry, watches,
- wearing operating underwear,

- using masks and caps, changed after each treatment or more often, depending on the need,
- a ban on the work of people with oozing lesions on their hands,
- small wounds should be covered with a sterile dressing,
- Put on sterile gloves after putting on the gown.

Perioperative antibiotic prophylaxis

There are three models for the use of antibiotic prophylaxis [Abdelgawaad et al., 2021; Costa et al., 2021]:

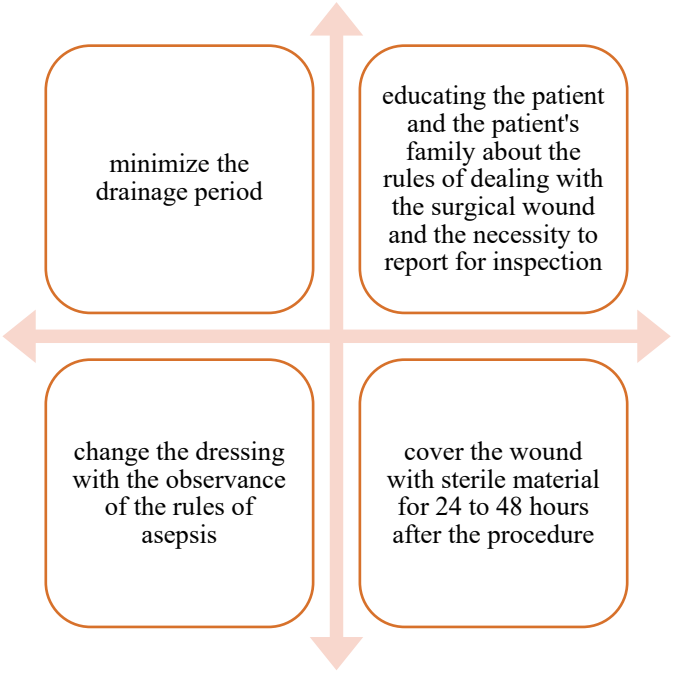
- one-shot prophylaxis - one dose of antibiotic given during anesthesia,
- ultra-short prophylaxis - three doses of an antibiotic, the first of which was given 2 hours before the procedure and the rest on the day of the procedure,
- short-term prophylaxis - the use of an antibiotic for 24 to 72 hours, of which the first dose is administered 2 hours before the surgery.

Proceedings during surgery [Lasne et al., 2006; Adams et al., 2011; Ho et al., 2019; Olivares et al., 2020; Croke 2021; Rowinski and von Schreeb, 2021]:

- maintaining adequate ventilation, humidity and temperature in the operating room,
- limiting the number of personnel entering the operating room,
- surgical instruments sterilized in accordance with the guidelines,
- storage of packages, sterile materials, implants in accordance with the guidelines,
- counting the material used during the procedure,
- quick sterilization used only in exceptional situations,
- washing and disinfection in the operating room should be carried out according to established rules,
- surgical technique: maintaining adequate hemostasis, gentle tissue holding, minimization of dead tissues and foreign bodies, adaptation of the incision to the extent of the procedure, closure of the surgical wound according to the art, limited coagulation to the vessel itself, drainage performed from a separate incision.

Post-operative procedure

It is a procedure in the period immediately after the surgery until the wound heals [Zoccaliet al., 2017; Kehlet, 2020; Steen et al., 2020]



Cooperation with the Central Sterilization Room

Decontamination breaks the chain of microbial transmission to both patients and workers. People who use sterile medical devices, as well as people involved in the decontamination process, must have knowledge in this topic. Each operating theater should use the services of a sterilization room, where the process of washing, disinfecting, drying, checking, packing, marking and sterilizing tools with the method recommended by the manufacturer is carried out, and storage until they are transferred to the operating theater [Jenkins, 2020].

Infection Control Committee

The Act of 5 December 2008 Dz.U.2022.1657 on the prevention and combating of infections and infectious diseases obliges the managers of medical entities that perform medical activities such as hospital services to implement an efficiently functioning system of preventing and combating hospital infections [Dz.U.2022.1657. Act in force – Polish version]. It is necessary to establish and supervise the work of the Committee and the Hospital Infection Control Team. Gathering information and keeping a registry of nosocomial infections and alert factors is the

first step in taking measures to reduce the risk of SSI [Giroti et al., 2018; Dz.U.2022.1657. Act in force – Polish version].

Conclusion

Surgical site infection is an avoidable complication, yet it is a worldwide problem. The human factor plays an important role in the prevention of surgical site infections, so the work should be performed in accordance with the standards, procedures and instructions developed on the basis of current medical knowledge, constantly updated through training and skills improvement.

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NOSOCOMIAL INFECTIONS CAUSED BY *CLOSTRIDIOIDES DIFFICILE* – MONITORING THE EPIDEMIOLOGICAL SITUATION

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Abstract

Clostridioides difficile is a gram-positive spore-forming, anaerobic toxoid that is responsible for most antibiotic-induced diarrhea and nosocomial infections. In most cases, it is an endogenous infection, but an exogenous infection can also occur through the transfer of rods or spores of toxigenic strains from patient to patient through the hands of hospital staff. Infection also spreads through the fecal-oral route. The aim of the study was to analyze the incidence of gastrointestinal infections caused by *C. difficile* in hospital wards, divided into medical and surgical wards. The analysis was made on the basis of hospital infection cards analyzed by the Hospital Infection Control Team in 2021 at Mazovian Specialist Hospital Ltd in Radom (Poland). The patient incidence rate caused by *C. difficile* in 2021 was 0.25 %, considering treatment wards, while the number of infections with this bacterial etiology per 1 hospital bed was 6.81 %. In conservative departments, the incidence rate was 0.52 %, and the number of infections per bed was 10.87 %. When comparing the incidence rates and the rates of digestive system infections occurring in the treatment and conservative departments, it was noticed that they were significantly higher in the conservative departments. Infections caused by this pathogen constitute a growing therapeutic problem in the hospital. The basis of infection prevention and control are single-person hospital rooms with separate bathrooms, toilets, hand washing and disinfection agents, and personal protective equipment for medical personnel. Educating patients and their families, and, above all, medical personnel in compliance with

hygiene procedures, can help to prevent the spread of the pathogen and reduce the number of cases.

Keywords: *Clostridioides difficile*, infections of the digestive system, nosocomial infections

Introduction

Clostridium difficile species was reclassified based on the analysis of phylogenetic, phenotypic and chemotaxonomic data. Currently, the correct species name is *Clostridioides difficile* [Lawson et al., 2016]. It is an anaerobic, gram-positive spore-producing bacillus that is responsible for severe diarrhea that can lead to many complications such as: *colitis pseudomembranosa*, giant colon (*megacolon toxicum*) and patient death. The bacterial infectious agent, host genetics, comorbidities, and previously administered medications are responsible for this wide variety of diseases caused by *C. difficile*. In 2011, 500.000 were infected people in the US, of which 29 thousand died. *Clostridioides difficile* infection (CDI) is the most common healthcare-associated infection in the US and leads to a significant increase in treatment costs [Sandhu et al., 2018; Abbas and Zackular, 2020; Cho et al., 2020]. The diagnosis of CDI is based on the clinical signs of diarrhea (≥ 3 loose stools in 24 hours). It is also important to monitor relapses in patients with a prior episode of CDI. Relapses were defined as *C. difficile* diarrhea occurring 2-8 weeks after the first episode of CDI [Martirosian et al., 2018]. In the past, *C. difficile* infections were considered easy to diagnose and treat. However, the continuous development of diagnostic techniques and a better understanding of the pathogenesis of infections meant that it was understood that the topic of CDI was underrated and misdiagnosed. In the past, metronidazole was considered a first-line drug, but today it has been proven that better efficacy in curing patients has, among others, vancomycin and fidaxomicin [Guery et al., 2019]. Unfortunately, the growing resistance to antimicrobials makes it more and more difficult to cure the patient and poses a serious threat to the healthcare system. The problem was highlighted not only among patients infected with *C. difficile* in need of therapy, but also as a potential source of resistance genes that may be passed on to other microorganisms. It was noted that plasmids, ie extrachromosomal genetic elements capable of horizontal transfer, containing genetic information on antibiotic resistance, may play an important role in the development of resistance to antibacterial drugs [Włodarczyk and Giersz, 2006; O'Grady et al., 2021]. It was also noted that intestinal microbiota transplantation has a very beneficial effect in the treatment of CDI patients [Guery et al., 2019]. A very important issue in the prevention of *C. difficile* infections is the introduction of a number of rules of

conduct in the hospital environment that significantly limit the spread of this microorganism, ranging from the hygiene of staff hands, isolation / cohortation of patients, disinfection of the hospital environment and rational antibiotic therapy [Islam et al., 2013].

Aim of the work

The aim of the study was to analyze the incidence of gastrointestinal infections in 2021 caused by *Clostridioides difficile* in hospital wards, taking into account the division into conservative and surgical wards, based on the example of Mazovian Specialist Hospital Ltd in Radom (Poland). The obtained results were compared with data from other treatment facilities to determine whether the incidence of C. difficile gastrointestinal infections is higher or lower compared to other hospitals.

Materials and methodology

In order to perform the analysis, epidemiological data from 2021 from hospital wards were used. Infection monitoring reports were prepared on the basis of the number of registered infection cards in the first and second half of 2021. This study also uses data on the number of hospitalizations in the analyzed period and the number of beds in individual departments. The analysis concerned the following surgical departments: Hospital Clinical Department of Neurosurgery, Clinical Department of General, Oncological and Metabolic Surgery, Trauma and Orthopedic Surgery Department, Clinical Gynecology and Obstetrics Department, Pediatric Surgery Department and conservative departments: Internal Department II, Clinical Internal Department I, Rheumatology Department Department of Rehabilitation, Department of Pulmonology and Pulmonary Oncology, Clinical Department of Paediatrics, Clinical Department of Oncology, Department of Anaesthesiology and Intensive Care, Department of Cardiology and Department of Hematology.

Results and discussion

The analysis was based on the nosocomial infection cards analyzed by the Hospital Infection Control Team in 2021. They were used to create a report on the monitoring of nosocomial infections. The number of infection cards sent to individual wards is presented in Table 1.

Tab. 1 Number of registered infection cards with division into the first and second half of 2021 and into treatment and treatment wards

Name of hospital departments	**Number of registered cards 1st half of the year**	**Number of registered cards 2nd half of the year**
Conservative departments		
Department of Hematology	11	21
Clinical Department of Cardiology	19	20
Department of Anaesthesiology and Intensive Care	38	8
Clinical Department of Oncology	27	39
Clinical Department of Paediatrics	39	60
Department of Pulmonology and Pulmonological Oncology	45	27
Rehabilitation Department	11	3
Subdivision of Rheumatology	3	6
Internal Clinical Department I.	44	43
Internal Branch II	89	75
Oddziały zabiegowe		
Hospital Clinical Department of Neurosurgery	3	6
Clinical Department of General, Oncological and Metabolic Surgery,	20	20
Department of Trauma and Orthopedic Surgery,	16	14
Clinical Department of Gynecology and Obstetrics,	1	0
Department of Pediatric Surgery	4	5

From the obtained infection cards, infections related to the digestive system were counted, additionally using information on the number of hospitalizations and the number of beds in individual wards, the following were calculated: the incidence rate among hospitalized patients and the rate of infections per hospital bed (Table 2).

Tab. 2 Numbers of nosocomial infections affecting the digestive system and the number of hospitalizations and beds in surgical wards

Name of hospital departments	**Infections of the digestive system**		**Number of hospitalizations**		**Number of beds**	
Treatment departments	1st half of the year	2nd half of the year	1st half of the year	2nd half of the year	1st half of the year	2nd half of the year
Department of Pediatric Surgery	5	1	611	733	25	15
Clinical Department of Gynecology and Obstetrics	1	0	1300	1388	55	55
Orthopedic Surgery Department	2	0	1644	1681	60	60
Clinical Department of General, Oncological and Metabolic Surgery	11	11	1684	1535	56	56
Hospital Clinical Department of Neurosurgery	0	1	470	520	20	20

The incidence rate of all gastrointestinal infections among the surgical wards was 0.28%, but if only *C. difficile* infections were taken into account, it was 0.25%. The number of digestive system infections per one hospital bed among surgical wards was also calculated. This number accounted for 7.58% for all infections of the digestive system, while the number of *C. difficile* infections per one hospital bed was 6.81%. These indicators were calculated separately for conservative departments. The data are presented in Table 3.

In conservative departments, the incidence rate for all gastrointestinal infections was 1.08 % in 2021. If only *C. difficile* infections were taken into account again, it was 0.52 %. The infection rate per hospital bed among medical wards totaled 22.95 %, while after counting only infections caused by *C. difficile*, it decreased by more than half and amounted to 10.87%. When comparing the incidence rates and the rates of digestive system infections occurring in the treatment and conservative departments, it was noticed that they were significantly higher in the conservative departments. This is mainly due to the specific nature of these departments, and in most cases to patients hospitalized in these departments. These are mainly patients with numerous comorbidities, often in old age, who are much more likely to develop post-antibiotic diarrhea caused by an anaerobic gram-positive cyst. The infection caused by *C. difficile* is also influenced by the length of stay in the hospital ward, contact with an infected patient,

compliance with hand hygiene among medical staff and patients, and the applied antibiotic therapy.

Tab. 3. Numbers of nosocomial infections affecting the digestive system and the number of hospitalizations and beds in conservative wards

Name of hospital departments	**Infections of the digestive system**		**Number of hospitalizations**		**Number of beds**	
Conservative departments	1st half of the year	2nd half of the year	1st half of the year	2nd half of the year	1st half of the year	2nd half of the year
Internal Branch II	13	9	1009	990	36	36
Internal Clinical Department I.	15	5	760	725	36	36
Subdivision of Rheumatology	1	0	235	373	15	15
Rehabilitation Department	3	0	305	500	67	67
Department of Pulmonology and Pulmonological Oncology	4	5	1214	1376	65	52
Clinical Department of Paediatrics	36	55	558	670	24	14
Clinical Department of Oncology	5	1	823	792	42	32
Department of Anaesthesiology and Intensive Care	1	0	219	176	11	11
Clinical Department of Cardiology	3	5	1779	1630	59	59
Department of Hematology	1	3	558	637	21	21

According to [Zhu et al., 2018], *C. difficle* is the bacterium responsible for most post-antibiotic diarrhea. It can constitute the intestinal microbes in 3-5 % of adults and in 50 % of infants without causing any discomfort. In contrast, overdiagnosing asymptomatic colonization as a disease has become a major problem, as investigated by [Doll et al., 2021]. Among hospitalized patients, the carrier status is much higher in 10-30%, which may indicate that CDI is a nosocomial infection. In most cases it is an endogenous infection. On the other hand, exogenous infection can also occur through the transfer of bacilli or spores of toxigenic strains from patient to patient using the dirty hands of hospital staff. Moreover, infection spreads through the fecal-oral route [Szewczyk, 2019; Albrecht and Pituch, 2013].

An important element in the prevention of nosocomial infections is the early detection of the pathogen. The diagnosis of CDI is based on the clinical symptoms of the patient, i.e. diarrhea ≥ 3 loose stools in 24 hours. The shape of the stool should fit the container or correspond to types 5-7 on the Bristol scale [Lewis and Heaton, 1997; Caroff et al., 2014]. Diagnostics may also be based on the finding of pathological dilatation of the large intestine in a radiological examination (*mgacoclon toxicum*) - giant colon. In addition, for the diagnosis of CDI, at least one condition should be met, i.e. the presence of A / B toxins or binary toxin in the stool, the

presence of *pseudomembranous enteritis* (*colitis pseudomembranosa*) in endoscopic or radiological examination or during surgery [Kuijper et al., 2006; Debast et al., 2014]. Recurrences of CDI most often occur within days to weeks after stopping treatment with antibacterial agents. One of the main reasons for the occurrence of recurrences is disturbance of the intestinal microbiome after discontinuation or discontinuation of antibiotic treatment, which causes *C. difficile* spores in the intestines of patients to sprout into a vegetative form [Zhu et al., 2018; Feuerstadt et al., 2022]. A severe form of CDI was also distinguished, which most often requires hospitalization in an intensive care unit or colectomy or is fatal. The severe form of the disease has a complex, systemic action of toxins, shock and severe enteritis [Debast et al., 2014]. The fulminant form concerns patients with severe CDI who additionally experience shock or hypotension, intestinal obstruction or the large intestine [McDonald et al., 2018].

Epidemiology has changed significantly in recent years and the incidence of *C. diffcile* infections has increased significantly. In 2010 in the USA, the number of cases in hospitals was higher than the number of infections with MRSA (*methicyllin-resistant Staphylococcu saureus*) strains. In contrast, Canada reported between 1991 and 2003 that *C. difficile* infections increased from 36 to 156/100,000. The epidemic strain NAP1, or ribotype 027 or 027/NAP1/BI, is mainly responsible for this drastic increase in the occurrence of CDI in the world. It is a hypervirulent strain with an increased ability to produce toxins A/B and binary toxin, increased ability to form spores, resistance to fluoroquinolones and causing more severe infections. In Poland, the first such strain was bred in 2005 at the Central Teaching Hospital in Warsaw [Martirosian et al., 2018; Albrecht and Pituch, 2013].

In order to reduce the spread of CDI, an infection control strategy must be developed in the healthcare setting. The basis for the prevention and control of infections are single-person hospital rooms with isolated bathrooms, toilets as well as agents for washing and disinfecting hands and personal protective equipment for medical personnel [Tschudin-Sutter et al., 2018]. Patients should be instructed to wash their hands thoroughly with soap and water after using the toilet, but also to use the shower frequently to remove spores from the body [Adam, 2017]. It was shown to be more effective in removing spores with water and soap compared to alcohol-based preparations. In cases where the isolation of patients is not possible, cohort patients with the same organism [El Feghaly et al., 2013]. Disposable equipment is dedicated to patients with CDI. If this is not possible, reusable equipment should be decontaminated with sporicides [Muto et al., 2007]. The same funds should be used for the final cleaning of the hospital room. In order to limit the spread of the infection, it is possible to use a closed system for the controlled

collection of stools. This solution is a great help in patient care [Goldenberg et al., 2017; McFarland, Ship et al., 2018]. Nursing staff is able to more accurately assess the fluid balance, but it also results in an improvement in the patient's mental and physical comfort [Ott et al. 2017; Ianiro et al., 2018]. Additionally, an important aspect in reducing CDI is rational antibiotic therapy. The frequency and duration of therapy should be minimized, especially as regards antibiotics with a high risk of *C. difficile* infection. The supervision should especially concern fluoroquinilones, clindamycin and cephalosporins [Martirosian et al., 2018].

Conclusions

The greatest number of infections caused by *C. difficile* was found in conservative wards, such as: Internal Ward II, Internal Clinical Ward I, Pulmoology and Pulmonological Oncology Ward, Clinical Department of Paediatrics. On the other hand, in surgical wards, the highest number of infections was found in the Clinical Ward, General, Oncological and Metabolic Surgery Ward, and in the Trauma and Orthopedic Surgery Ward. The patient incidence rate caused by C. difficile in 2021 was 0.25%, considering treatment wards, while the number of infections with this bacterial etiology per 1 hospital bed was 6.81%. In conservative departments, the incidence rate was 0.52%, and the number of infections per bed was 10.87%. When comparing the incidence rates and the rates of digestive system infections occurring in the treatment and conservative departments, it was noticed that they were significantly higher in the conservative departments. Infections caused by *C. difficile* is a growing problem due to the increase in morbidity and therapeutic difficulties, not only in Poland, but also in the world. Educating patients and their families, and above all medical personnel, on compliance with hygienic procedures can help prevent the spread of the pathogen and reduce the number of cases of illness.

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IDENTIFICATION OF FALL RISK IN SENIORS

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Abstract

Introduction: Falls are one of the most common causes of injuries in senior citizens and the fifth common cause of death. The first step to eliminate falls in the hospital environment is to identify at-risk patients.

Methodology and characteristics of the sample**:** 480 senior respondents (average age 77.38 years) hospitalized in institutional health facilities in Bratislava participated in the research study. The standardized assessment tool Morse Fall Scale (MFS) was used to process the defined research objectives.

Results: We diagnosed a high fall risk in up to 61.25% of the participants involved, and the incidence of fall in the personal history of hospitalized seniors was associated with their age ($p < 0.00001$). The results confirm a statistically significant relationship between the incidence of fall in the past 3 months and the fall risk classification by MFS screening ($p = 0.000$).

Conclusion: Based on the research results, fall risk in hospitalized elderly patients was confirmed.

Keywords: seniors, fall, fall risk factors, nursing, standardized scale

Introduction

Falls are one of the most frequent causes of injuries in people in the geriatric age and the fifth most frequent cause of their death (Krajčík, 2006; Neyens et al., 2009). Falls in this age group occur in different environments (home, outside, institutional, hospital) and are determined by several subjective factors. The World Health Organization referred to the increasing tendency of falls in hospitalized patients due to the fact of geographical aging of the population in the Global report on falls prevention in older age (2007) already in 2007. It estimates up to a 100% increase in falls of geriatric patients in 2030. There are several statistical indicators currently available on the incidence of this serious emergency event in health care. The Public Health Agency of Canada (2014) in the document SeniorS' FallS in Canada lists seniors as the largest

population group at risk of falls. While in 2006 and 2007 there were 67,899 patients aged 65 years and older admitted to Canadian hospitals due to falls, in 2010 and 2011 there were already 78,330 patients. Similarly, according to the System National Health Surveillance Agency, falls in hospitals represent the third most common extraordinary event. Data from this system show that from March 2014 to March 2017, more than 12,000 falls were reported in Brazilian hospitals (Bausch et al., 2017). In the document by the National Health Service Improvement (2017) is stated that approximately 247,000 patient falls (of which 190,000 were in patients over 65 years) were reported in hospital facilities in England in 2015–2016. Castellini et al. (2017) recorded 365 incident reports between January 2014 and March 2015 in 40 hospital departments in northern Italy. Of this number, a fall was reported in 349 (95.6%) geriatric patients. Also, Corsinovi et al. (2009) in the conducted study (Italy) concluded that in the monitored number of 620 patients in the geriatric ward, a total of 80 falls occurred in 70 patients. A numerical overview of falls in the Urban Academic Medical Center in New York for the period of 2011 was observed by Anderson et al. (2016). During the monitored period, they demonstrated the incidence of 1,767 (97.0%) falls during hospitalization in the age range of 49 to 80 years and older. Similarly, Bouldin et al. (2013) present findings related to fall incidence in 1,263 hospitals across the United States of America during the observation period from July 2006 to September 2008. During this period, a total of 315,817 falls occurred, of which 82,332 (26.1%) resulted in injury. In the Slovak Republic, data on falls in hospitalized patients are available from year 2013. The Health Care Surveillance Authority in the Activity report lists 3,075 falls and patient injuries that occurred in 65 institutional health facilities in the Slovak Republic. However, falls in geriatric patients were not reported in separate statistics. The first step in eliminating falls in the hospital environment is to identify at-risk patients (Stevens, 2005). Pokorná et al. (2017) recommend assessing fall risk in a patient within 24 hours of admission to a hospital to identify risk factors known to increase fall risk. Clinical practice currently has at its disposal a set of standardized simplex and multidimensional measurement tools for their detection. They mostly contain combinations of several subjective risk factors – age, physical, psychological and environmental risk factors, risk factors of pharmacotherapy and others (e.g. Assessment of High Risk to Fall, Downton Fall Risk Index, Fall Assessment Questionnaire, Falls Screening Tool, Falls Risk for Hospitalised Older People, Hendrich Fall Risk Model, Morse Fall Scale, Patient Fall Questionnaire and others). The most frequently used ones in clinical practice are the Morse Fall Scale, Hendrich Fall Risk Model and St. Thomas's Risk Assessment Tool in Falling Elderly Inpatients over 65 years. The selection of an adequate measurement tool depends on the patient's age, current state of health, environment, and other situational factors (Bóriková et al., 2019).

Methodology and characteristics of sample

The empirical investigation conducted in hospitalized geriatric patients aimed to determine fall incidence in the past 3 months in the personal history, to classify the level of fall risk by the Morse Fall Scale (MFS) screening, to determine the prevalence of individual fall risk factors, and to determine the association between fall incidence in the patient's history and classification of fall risk according to MFS, and between fall incidence in the patient's personal history and other variables of the Morse Scale.

The sample consisted of 480 respondents. The criteria for their inclusion to the sample were senior age according to the WHO (at least 60 years), hospitalisation in an institutional health facility, and assessment of fall risk within 24 hours after admission. Patients hospitalized in geriatric, surgical and internal wards participated in the survey. The average age of the respondents was 77.38 years, with a range of 60–97 years (median 78, SD ± 9.45). The detailed demographic structure of the respondent sample is presented in Table 1.

Tab. 1 Socio-demographic characteristics of the respondent sample

Variables	**Categories**	**n**	**%**
Gender	Women	302	62.92
	Men	178	37.08
Age	60 – 74 years	204	42.5
	75 – 89 years	232	48.33
	90 years and more	44	9.17
Ward of hospitalization	Geriatric	198	41.25
	Surgical	70	14.58
	Internal	212	44.17
Total		480	100

To process the defined problem, we used a protocol that contained items focused on the identification data about respondents (gender, age, ward of hospitalization) and the Morse Fall Scale. Six significant risk factors were assessed using the MFS: history of fall, associated diagnosis, walking aid, intravenous cannula/therapy, gait type and mental state. In individual risk factors, the patient could get 0–30 points (range 0–125 points). A resulting score of 0 points indicated no fall risk, <25 points represented a low fall risk during hospitalization, a score between 25 and 45 points indicated a moderate fall risk, and patients classified >45 points were at high risk of falling (Morse et al., 1989).

The survey was carried out in March 2018 – June 2019. Descriptive statistics was used to interpret the results, and statistical significance of differences between categories was tested by chí^2 test. We presented mainly significant results such as differences at the $p < 0.05$ level. We used SPSS version 18 for statistical evaluation.

Ethic

A protocol for obtaining empirical data was included in the medical record. The medical documentation in the Slovak Republic also contains education of the patient and informed consent to the provided health care. Hospitals allow the use of medical documentation also for study purposes under the legislation of the Slovak Republic while preserving the confidentiality of the information in accordance with the legislation in force.

Results

In the sample of 480 examined geriatric patients, we recorded the occurrence of fall in the personal history in the past three months in 260 (54.17%). When comparing fall incidence in the past three months according to the gender of the respondents, we did not find any statistically significant differences ($p = 0.402$). In the group of men, we registered a fall in 51.69% of cases and in the group of women in 55.63% of cases. The fall incidence in the personal history was associated with age. By far the most falls were diagnosed in respondents in the age category ≥ 90 years (77.27%), the least in the age category 60–74 years (40.00%) ($p < 0.00001$). The incidence of falls in the personal history by gender and age of respondents is presented in Table 2.

Then we classified the level of fall risk in the selected sample of respondents. In the sample of 480 respondents, the average fall risk score according to the MFS was at the high-risk level: 55.87 ± 24.2 (minimum 0, maximum 115). Based on the resulting MFS score, we divided respondents into four fall risk categories. A high fall risk was diagnosed in up to 61.25% of the participants involved, a medium fall risk in 30.42%, a low fall risk was recorded in 7.08%, and only in 1.25% the MFS didn’t confirm any fall risk.

Tab. 2 Fall incidence in personal history in the past 3 months by age and gender of respondents

Variables	Categories	History of fall		
		Yes n (%)	No n (%)	*p*
Gender	Men	92 (51.69)	86 (48.31%)	0.402
	Women	168 (55.63)	134 (44.37)	
Age	60–74 y.	82 (40.0)	122 (59.8)	**< 0.00001**
	75–89 y.	144 (62.07)	88 (37.93)	
	≥ 90 y.	34 (77.27)	10 (22.73)	
Total		260 (54.17)	220 (45.83)	

The analyses further revealed that the number of hospitalized geriatric patients with high fall risk increases with their age, from 44.12% of respondents aged 60–74 years, to 72.41% aged 75–89 years, and then up to 81.82% of patients older than 90 years. The frequencies of representation of respondents in the other levels of fall risk (medium, low and none) showed opposite trends ($p < 0.00001$). We did not notice statistically significant differences in the distribution of individual fall risk levels by gender (Table 3).

Tab. 3 MFS Classification of fall risk by gender and age of respondents

Variables	Categories	Fall risk classification				
		None n (%)	Low n (%)	Medium n (%)	High n (%)	*p*
Gender	Men	2 (1.12)	12 (6.74)	56 (31.46)	108 (60.67)	0.977
	Women	4 (1.32)	22 (7.28)	90 (29.8)	186 (61.59)	
Age	60–74 y.	4 (1.96)	24 (11.76)	86 (42.16)	90 (44.12)	**< 0.00001**
	75–89 y.	2 (0.86)	6 (2.59)	56 (24.14)	168 (72.41)	
	≥ 90 y.	-	4 (9.09)	4 (9.09)	36 (81.82)	
Total		6 (1.25)	34 (7.08)	146 (30.42)	294 (61.25)	

The causes of falls in hospitalized patients were multifactorial. The analysis of results showed fall incidence in the personal history in 260 (54.17%) patients and up to 438 (91.26%) study participants had an associated diagnosis. The prevalence of comorbidity increased proportionally with their age ($p < 0.00001$), its highest incidence was observed in the oldest age

category (97.72%) and the lowest incidence in the youngest age group (82.35%). The compensatory walking aid was used by 216 (45.00%) respondents (crutches, cane or walker 35.42%; furniture 9.58%). Compensatory walking aids were more often used by women ($p = 0.005$) and long-lived patients ($p < 0.00001$). We registered the presence of intravenous therapy or cannula in 254 (52.92%) respondents and abnormal gait in 240 (50%) respondents (poor gait 35.83%, gait impairment 14.17%). Poor gait occurred significantly more often in women and gait impairment in men ($p = 0.001$). The highest prevalence of poor gait was diagnosed in the age category of 90 years and over (50.00%), the lowest in the age category of 60–74 years (30.39%). Gait impairment was significantly more prevalent in patients aged 75–89 years ($p = 0.014$). We registered a mental disorder in 112 (23.33%) patients. The incidence of mental disorders increased with age until the age of 89 years (11.76% in the age category 60–74 years; 31.9% in the age category 75–89 years), in the latter age category, the prevalence of mental disorders did not change (31.8%) ($p < 0.00001$).

In the intentions of the last study objective, we verified the existence of association between fall incidence in the patient's history and the fall risk classification according to the MFS, as well as between fall incidence in the personal history of the patient and other variables of the MFS. The results confirm a statistically significant relationship between fall incidence in the past 3 months and the fall risk classification by MFS screening ($p = 0.000$). A group of respondents who proclaimed a fall in their personal history in the past 3 months were also more likely to have a high fall risk (Table 4).

Data analysis further confirmed that there was a significant association between documented falls in the personal history in the past three months and polymorbidity ($p = 0.008$) and intravenous therapy or cannula ($p = 0.028$). The association between a fall in the personal history of the geriatric patient and other MFS risk factors was not confirmed (Table 4).

Tab. 4 Classification of fall risk and MFS risk factors by fall incidence in personal history

Variables/categories	Fall in personal history			
	Yes n (%)	No n (%)	Total n (%)	*p*
MFS classification				
No fall risk	-	6 (100)	6 (1.25)	
Low fall risk	-	34 (100)	34 (7.08)	**0.000**
Medium fall risk	40 (27.4)	106 (72.6)	146 (30.42)	
High fall risk	220 (74.83)	74 (25.17)	294 (61.25)	
Fall risk factors				
Associated diagnosis	248 (56.62)	190 (43.38)	438 (91.25)	**0.008**
Walking aid				
Crutches, cane or walker	88 (51.76)	82 (48.24)	170 (35.42)	0.727
Furniture	26 (56.52)	20 (43.48)	46 (9.58)	
IV cannula	150 (59.06)	104 (40.94)	254 (52.92)	**0.028**
Gait				
Poor gait	100 (58.14)	72 (41.86)	172 (35.83)	0.145
Abnormal gait	30 (44.12)	38 (55.88)	68 (14.17)	
Mental disorder	66 (58.93)	46 (41.07)	112 (23.33)	0.295
Total	260 (54.17)	220 (45.83)		

Discussion

Falls of geriatric patients during hospitalization complicate their treatment, have serious physical, psychological and social consequences, increase the economic costs of health care and put health care facilities at risk of legal consequences for failing to provide sufficiently high-quality and safe health care. Identification of fall risks is necessary to improve the safety of this group of patients. In the Slovak republic, there are currently no up-to-date national statistics on fall incidence in geriatric patients during hospitalization. Although the Activity report from 2013 reports 3,075 falls and patient injuries that occurred in 65 institutional health facilities in the Slovak republic, fall incidence related to the age of patients is not stated. This problem also occurs in several other national and foreign studies. For comparison in discussion, we tried to find similar studies in the databases **BioMed Central**, PubMed, **Web of Science**, Free Medical Journal, OECD Factbook, **SpringerLink**, **Infotrac** and others. In our study, we recorded fall incidence in the personal history in the past three months in 260 (54.17%) geriatric patients from a total of 480 examined patients hospitalized in Slovak hospitals. When comparing fall incidence in the past three months by gender, we didn't find any statistically significant differences (p = 0.402). In the study, fall incidence in the personal history of the

patient was associated with age. By far the most falls were diagnosed in respondents in the age category ≥ 90 years (77.27%), the least in the age category 60–74 years (40%) ($p < 0.00001$). Similar findings are reported by Hajduchová et al. (2019) – in the analysis of 250 falls in different hospital wards, the average age of patients was 76.9 years. Fall incidence in the hospital environment is also pointed out by Anderson et al. (2016). They state that of the total number of 1,822 documented falls in the Urban Academic Medical Center, 80.8% occurred during hospitalization in the inpatient wards. The authors further state that falls occurred more often in the male population (51.8%) compared to women (48.2%), but this cannot be considered a significant difference. They also found out that the most falls were registered in the group of patients ≤ 49 years old (n = 324 – i.e. 24.9%), less in the group of 70–79 years old (n = 262, i.e. 20.2%) and the least in the group of ≥ 80 (n = 205, i.e. 15.8%), which does not correspond to our findings. The percentage is affected by the number of respondents in specific age categories. In the study conducted by Adly et al. (2019), the relationship between malnutrition and fall risk in the geriatric inpatient ward (age = (mean±SD) 68.67) at Ain Shams University Hospital in Cairo was also mapped. The MFS was used to determine fall risk. In the results, they reported a high fall risk in 28 (14.7%) and medium risk in 101 (53.2%) of the total number of monitored geriatric patients. A cross-sectional, prospective and descriptive study with the use of the MFS was also conducted in 75 respondents (average age 71.3 years ((SD ± 8.2) by Sarges et al. (2017) in the hospitals in selected regions in Brazil. A high fall risk was confirmed in 52.0% and low risk in 18.7% of the total number of hospitalized geriatric patients.

Compared to the two aforementioned studies, the results of our study showed a high fall risk in up to 61.25% of the total number of respondents. Gringauz et al. (2017) in the retrospective cohort analysis of a group of 428 patients aged 76.8 ± 14.0 years confirmed that according to the MFS (9 or more), all of them had a high fall risk and their average MFS score was 16.2 ± 6.1. In our observed sample of 480 geriatric patients, the average fall risk score based on the MFS was at the high-risk level 55.87 ± 24.2. Bóriková et al. (2018) in the descriptive and correlation study mapped fall factors and fall risk screening (by the MFS) in 89 (average age 82.8 SD ± 5.9; min. 70, max. 95) geriatric patients hospitalized in two selected facilities in the Slovak Republic. The average fall risk score according to the MFS was calculated from 4 measurements. A low fall risk was identified in 23 geriatric patients (25.8%), medium risk in 44 geriatric patients (49.5%) and a high fall risk was confirmed in 22 of them (24.7%). In our monitored sample, a high fall risk was diagnosed in a significantly higher number of geriatric patients (61.25%). A high fall risk – 45.0% of the total number of 284 monitored geriatric patients was also confirmed in the study by Falcão et al. (2019). In relation to gender, we did

not observe any significant statistical differences in the frequency of specific fall risk levels (Table 3). Similar results were also published by Falcão et al. (2019) – a high fall risk was registered in 24.6% of the female population and 20.4% in men. Similar to our study, other authors also confirmed multifactorial conditioning of falls in geriatric patients. In our results, associated diagnosis (91.25%) and the personal history (54.7%) dominated among the risk factors by the MFS. These fall risk factors by the MFS were also confirmed by Falcão, et al. (2019). Associated diagnoses were proved as fall risk in 228 (80.3%) and history of fall was demonstrated in 133 (46.8%) of the total number of 284 respondents. History of fall as a significant risk factor was also confirmed by Gadkaree et al. (2015) in the National Health and Aging Trends Study. Authors of another study Chu et al. (2015) also monitored fall risks in 342 elderly patients (age 79.5 ± 6.7 years) hospitalized in one of the Chinese hospitals. They confirmed that the most significant fall risk factor was history of fall. Correlation analysis and regression analysis also pointed to a significant relation between the MFS and Comprehensive Geriatric Assessment (CGA) scale ($p < 0.001$). However, the results by Bóriková et al. (2018) confirmed that only 7.9% (out of 89 respondents) had a personal history of fall, which does not correspond to our findings. A specific instrument of 3 questions related to history of fall (Question 1: "Have you fallen in the past 6 months?", Question 2: "Do you think that you might fall in the next few months?", Question 3: "What is the probability that you will fall in the next few months?") was used by Rodríguez-Molinero et al. (2017) in the age group older than 65 years in Spain. They concluded that repeated falls in the following period can be predicted based on respondent's answers. Although authors did not use the standardized MFS tool, they used an identical single fall risk factor – history of fall which is also included in the MFS. Another fall risk factor was also present in the category of our respondents – the use of a compensatory device (45.0%). A similar figure was recorded by Bóriková et al. (2018), who also confirmed a statistically significant correlation between this variable and a high fall risk ($p = 0.022$).

Conclusion

Our study, results of studies by different authors, as well as the WHO and several national organizations for patient safety, point to the urgency of addressing the problem of fall incidence in the geriatric population in various environments. An effective tool to prevent falls in this population group is prevention in the form of e.g. intervention programmes (Brabcová et al., 2020; Horová et al., 2017). Nurses play an important role in prevention. The first step in preventing falls is to identify at-risk patients through standardized methodologies. The National

Institute for Health and Care Institute (2013) recommends multifactorial assessment of elderly hospitalized patients, adequate selection, and subsequent application of individual or comprehensive (individual, group) prevention programmes.

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BODY POSTURE OF CHILDREN BETWEEN 6 AND 9 YEARS OF AGE IN THE AREA OF CZAPLINEK, POLAND

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Abstract

Introduction: The dynamics of developmental changes combined with changes in lifestyle make the growing organisms of children more and more often deviate from the norms determining the correct development. The early school period is the time when faulty postures appear, which, if not corrected at later stages, lead to the ossification of faulty posture. Most authors point to reduced physical activity as the leading cause of posture defects – the lack of physical activity leads to muscle weakness and, in combination with a poorly balanced diet, to overweight and obesity. Early detection of posture deformity is crucial for effective postural re-education involving compensatory and corrective classes at school; an increase is the number of exercises shaping the habits of correct posture, including care of the proper sitting position and employment of extracurricular exercises.

Aim: To assess the quality of posture of children aged 6 to 9 years dwelling in a small rural town environment.

Materials and methods: Four hundred twelve children (196 boys and 216 girls) from Czaplinek Primary School were examined. Body posture was evaluated according to the T-scoring method. Body height and weight were measured, and BMI was calculated for each child. Four posture quality categories were distinguished: normal posture (0 points), abnormal posture (1-2 points), faults in posture (3-5 points), and bad posture (> 5 points). Moreover, the share of abnormalities in selected body segments was assessed in relation to the overall score.

Results: In both genders, in each examined age category, there is a sizeable inter-personal variation in the scoring of posture quality.

Conclusion: The best posture characterizes six-year-olds of both sexes and the worst - nine-year-olds. The highest percentage of abnormalities in the examined the population of children aged 6-9 years were observed for scoliosis and abnormalities in plantar foot vaulting.

Keywords: children, correct posture, posture defects, Kasperczyk method

Introduction

The postural habits of children change with chronological years and school attendance period. The dynamics of developmental changes occurring in children starting school combined with suppression of spontaneous mobility, including the necessity of staying in a sitting position for a long time, carrying additional loads (school books), improper classroom lighting, forces the growing organism to differ from the norms determining the correct posture (Wolański 1958, Machucka and Pyclik 2016). At the same time, insufficient care of teachers regarding the correct body posture of children in school benches is observed. It is due to the focus given to theoretical knowledge and marginalization of the natural need for movement resulting in a decrease of extracurricular exercises. The early school period is the time when faulty postures appear, which, if not corrected at a later stage, lead to the ossification of faulty posture. It is in adult life the cause of pain, reduced quality of work, and deterioration of quality of life (QoL).

Diagnosis of posture defects in children and schoolchildren is the subject of interest of many scientific centers and is carried out in different regions of our country. As the leading cause of postural abnormalities, most authors indicate reduced physical activity (Woynarowska et al. 2000; Cabak and Wojnarowska 2004) - among children and adolescents, the dominant model of spending free time is watching TV, playing computer games, and using the internet (European Environment and Health Information System ENHIS 2006).

The deficit of physical activity leads to the weakening of muscle strength and, in combination with a poorly balanced diet, to overweight and, in extreme cases, to obesity, which has adversely influences child's growing (Ostojic et al. 2011, Malinowski and Bozilov 1997).

The prevalence of posture defects in children and adolescents has been for many years a matter of concern for scientists researching the development of the young generation. Despite many studies, apt conclusions, practical recommendations, and attempts to improve the situation, the condition of posture in the Polish population of children and adolescents is still deteriorating (Cover et al. 2011, Michalczyk- Paprocka et al. 2011).

The study is aimed to assess the quality of posture of children aged 6-9 years from a small rural town environment.

Materials and methods

The research was conducted between September 13th and 19th 2013. The analysis encompassed 412 children (196 boys and 216 girls) six to nine years of age from the Public Elementary School in Czaplinek.

The T-scoring method was used to assess body posture *Kasperczyk* (Kasperczyk 1994). The parents of the examined children were informed about the aim and method of the examination provided written consent for the study.

For each child, the body height (with an accuracy of 0.1 mm) and body weight (with an accuracy of 0.1 kg) were measured (Malinowski and Bozilov 1997). For each child, a body posture was assessed visually in frontal and coronal plains, including standing and leaning forward and sagittal planes. The proper anatomical alignment of the following elements was assessed for the head, shoulders, shoulder blades, spine, chest, abdomen, back, "waist triangles, pelvis, knees, and feet. A specific number of points was assigned for each element:

0 point – proper anatomical arrangement of the evaluated body part,

1 point - a slight deviation from the normal state,

2-3 points - significant deviation from the normal state,

3-5 points - high degree of distortion, structural changes.

As a result of somatoscopic evaluation, a specific total number of points each child was assigned. The higher the number of points, the worse the posture. For the overall assessment, four posture quality categories were distinguished:

correct posture (0 points),

disturbed posture (1-2 points),

defective attitude (3-5 points),

bad posture (above 5 points).

For each child, the specific age category was calculated in the decimal system based on the date of birth, date of examination, and the relevant conversion table [according to J.M. Tanner and R.H. Whitehouse, University of London, Institute of Child Health, for The Hospital for Sick Children Great Ormond Street, London, W.C.I]. The following age categories have been adopted:

5.5 ≤ 6 years < 6.5,

6.5 ≤ 7 years < 7.5,

7.5 ≤ 8 years < 8.5,

8.5 ≤ 9 years < 9.5.

Results

Basic parameters such as height, weight and BMI for children aged 6-9 are presented in Table 1.

Tab. 1 The descriptive characteristics of the participants (mean ± standard deviation M±SD)

Age group	Gender	Feature /feature			
		Age (years)	Body height (cm)	Body weight (kg)	BMI (kg/m²)
Six years	♂ (n=48)	6.0±0.3	115.9±4.7	21.2±3.7	20.0±4.5
	♀ (n=60)	6.3±0.3	115.5±5.3	22.1±5.0	21.3±5.6
Seven years	♂ (n=54)	7.1±0.3	123.9±5.9	26.0±5.3	18.3±4.2
	♀ (n=49)	7.1±0.3	122.9±6.1	25.7±6.5	18.3±4.8
Eight years	♂ (n=48)	8.0±0.3	129.9±5.6	29.5±6.3	17.4±2.5
	♀ (n=48)	8.0±0.3	127.4±5.3	27.0±5.4	16.5±2.4
Nine years	♂ (n=46)	9.0±0.3	135.3±6.2	32.0±6.8	17.3±2.8
	♀ (n=59)	9.0±0.3	134.9±5.9	33.3±8.2	18.2±3.4

The quality of the children postures shows a great diversity between individuals and age categories. In both genders, for each age category, there is a sizeable inter-personal variation in the scoring of posture quality. There are children defined by the correct posture (0 points) and with significant deviations from the norm (7, 8, and 9 points). Unfortunately, along with age increase, there is a gradual decrease in the number of children defined by the correct posture – the older the children are, the lower the general quality of the group posture for girls and boys (Table 2).

Tab. 2 The quality of the children postures

	6 years old	7 years old	8 years old	9 years old
	Girls/boys	girls/boys	girls/boys	girls/boys
correct posture [%]	35 / 40	18 / 22	35 / 17	19 / 20
disturbed posture [%]	45 / 25	41 / 37	27 / 25	29 / 35
defective attitude [%]	20 / 31	31 / 33	36 / 52	32 / 30
bad posture [%]	0 / 4	10 / 8	2 / 6	20 / 15

Comparison between the extreme age categories (six and nine years of age) unfold an analogous changes in both genders. Among six-year-old boys, 40% adopt the correct posture, whereas, among nine-year-old, only 20% adopt the correct posture. Among the six-year-old girls, the corresponding changes vary between 35% and 19%, respectively. Bad postures were defined for 4% among six-year-old boys and 15% among nine-year-old boys and 0% for six-year-old and 20% nine-year-old girls, respectively.

It should also be noted that in the nine-year-old boys' group, the defective and abnormal postures represent 65% and in girls 61%. It means that if appropriate corrective actions will not be adopted, these children from these groups will "fuel" the pool of adults defined bad posture. In six-year-olds of both sexes, there are the smallest problems in terms of posture abnormalities and defects, and correct postures are the largest. However, a question has to be posted if we are satisfied with as many as 60% of boys and 65% of girls who do not have the correct body posture? This fact indicates the need for preventive measures in the preschool period.

Table 3 presents the percentage of the shape abnormalities as the function of analysed body parts encompassing the overall posture score of the studied children.

In the six-year-old group of both sexes, the lateral curvature of the spine dominates. It accounts for more than half of all observed abnormalities (53.7% in boys and 59.1% in girls). The second most prominent feature of this age group are abnormalities of chest position and shape (20.4% in boys and 18.2% in girls).

Lateral curvature of the spine also dominated the group of seven-year-old girls and boys, but to a slightly lesser extent than in the group of six-year-old girls; 30.7% of boys and 27.8% of girls are defined by faulty spine curvature. At the same time, a high percentage of foot vaulting abnormalities (21.9% in boys and 29.7% in girls) and scapular alignment (24.6% in boys and 18.5% in girls) were observed in this group.

In an eight-year-old group of both sexes, analogous to younger children, the dominant abnormality was lateral curvature of the spine. It accounted for 32.6% of all abnormalities in boys and 38.2% in girls. It is followed by the foot vaulting abnormalities (26.4%) and shoulder

blades position (20.9%) in boys, and shoulder blades position (24.6%), and foot vaulting abnormalities (11.2%) in girls.

In the oldest study group (nine-year-old), of foot vaulting abnormality prevail among 34.8% boys and 36% girls, and scoliosis among 23.7% boys and 26.4% girls.

Tab. 3 Structure of posture abnormalities of children aged 6-9 years old from Czaplinek

Scoring posture segments according to T. Kasperczyk	(%) of participation of assessed body parts to the overall state of posture abnormalities							
	6 years		7 years		8 years		9 years	
	♂	♀	♂	♀	♂	♀	♂	♀
Placement of head	0	0	2.6	0	0.8	1.1	0.9	3.5
Placement of shoulders	0	0	7.0	8.3	5.4	6.7	7.6	3.0
Placement of shoulder blades	9.3	11.4	24.6	18.5	20.9	24.6	22.0	10.2
Placement and shape of chest	20.4	18.2	3.5	0.9	1.5	4.8	1.7	2.4
Placement of stomach	0	0	0	0	0	0	0	0
Development of chest kyphosis	7.4	0	3.5	0.9	3.1	0	0	2.4
Development of lumbar lordosis	5.5	2.3	0	0.9	0.8	6.7	5.1	3.6
Lateral curvature of the spine	53.7	59.1	30.7	27.8	32.6	38.2	23.7	26.4
Knee positioning	3.7	4.5	6.2	13.0	8.5	6.7	4.2	12.0
Foot vaulting abnormality	0	4.5	21.9	29.7	26.4	11.2	34.8	36.5
Total %	100	100	100	100	100	100	100	100

Discussion

The problem of the posture quality among preschool and school children is the subject of many studies and publications (Maciałczyk- Paprocka et al. 2011, Maciałczyk- Paprocka et al. 2012, Janiszewska et al. 2009). Their results and conclusions are alarming! A change in the attitude of parents, school educators, teachers, health professionals and decision makers is needed immediately. It becomes evident that increasing the number of hours of physical education (however desirable) does not bring the expected results in terms of improving health, including body posture quality resulting in the conclusion that the standards of physical education classes and extracurricular activities need to be verified and improved (Skorupka and Asienkiewicz

2014). There is no need to redefine the scope of health impact on children during school physical education classes. However, it is necessary to enforce the implementation of existing program and methodological assumptions. After all, the default elements of each lesson are general developmental shaping exercises and corrective exercises and shaping the habit of correct posture exercises, in the introductory and final parts of classes, respectively. We have more and more modern school playgrounds, gyms, playgrounds (566 sports complexes built in 2008, 1237 built from 2009 to 2010, 882 built from 2011 to 2012) (enerad.pl 2022). However, more children are defined by body posture defects, vide this report, and others (Śmigiel et al. 2017, Modrzejewska and Malec 2017, Wyszyńska et al. 2016, Mikołajczyk et al. 2015). Changes in civilization encompasing increasing pace of life, pauperization of society, increasing number of educational requirements and sedentary lifestyle influence the quality of body posture resulting in an increasing number of abnormal postures among children. Primarily it is perceived as an aesthetic flaw but later it QoL and becomes a significant medical and social problem.

The results of the presented study on body posture among children dwelling in Czaplinek, show a gradual posture deterioration during the first years of education. Out observation is consistent with the result of a similar study performed across the different administrative and geographical regions of Poland. However, to date, our study encompasses the larges group of studied subjects.

For example, analogous study was conducted by *Rosa and coworkers* (Rosa et al. 2013) reported the body posture of only fifty girls and fifty boys from grades 1 – 3 of the elementary school in Szczecinek was studied. There are also interesting similarities and discrepancies of the unknown origin between this and the later study. Thus, *Rosa et al*. reported lordotic changes of the first order among 20% of girls. In our study, we report 4.5%. Among boys, the percentage lordotic changes of the first order were similar and equal to 4% and 4.7% for Rosa et al. and this study, respectively. Also, *Rosa et al*. showed that changes in body head position define 40% of girls and 20% of boys, and changes in shoulder position define 22% of boys and 32%. Among the children reported in this study, the changes in the position of the head were fewer and amounted to 3.8% in girls and 3.4% in boys. Changes in shoulder position were observed in 12.8% girls and 16.4 boys. The outward shoulder blades is one of the most common posture deviation. Of the girls surveyed by Rosa et al., only 28% and 24% of boys did not show any abnormalities. In this study, these results were more optimistic (35.3% of girls and 46.6% of boys with normal shoulder blades).

Additionally, 50% of girls and 38% of boys from Szczecinek had scoliosis. In Czaplinek, this percentage was equal to 41.6 and 43.2. 46%, respectively. In boys, the percentage of those with no deviation from normal posture was 60% in Szczecinek and 19.6% in Czaplinek.

Also, *Szczepanik et al.* (2012) conducted research on children aged 7-8 years 106 children (52 boys and 54 girls) in Łódź and Krasna, Poland. The correct posture was present in 17% of boys and 20% of girls. The highest percentage of the examined children had problems with poor shoulder and shoulder blade alignment, boys 83 and 58%, girls 80 and 54% respectively; 19.7% of boys aged 7-8 years and 26.8% of girls of the same age had the correct posture. In children from the elementary school in Czaplinek, the above mentioned aspects of the poor posture are also present, but to a lesser extent, and amounts to 14.7% in boys with respect to shoulder position and 47% regarding shoulder blade position. In girls, 15.5% had shoulders that were badly set, and 41.2% had shoulder blades that were badly set. The correct footing was observed among 82.5% of boys from Łódź and Krasna and 62.3% of boys from Czaplinek. Girls in this category of disorders amount to 85% to 74.2% respectively.

However, the results of the study reported by *Widłak* (2010) are much more worrying than others. Among the children of elementary school in Kielce and its surroundings, the author did not recognize any defect only in one of the 507 children examined. The most frequent postural defects found include abnormal shoulder position and lateral curvature of the spine. Among children from Czaplinek it also played a major role in the structure of postural defects (29.9%). Among the children examined by *Widłak* the lateral curvature of the spine occurred in 84.1% living in the village and in 66.9% of children living in the city. Abnormal foot deformities were diagnosed in 48.7% of all examined children. In this study, this percentage was reported equal to 26.8%.

The body posture studies in children aged 6-12 years from Radom do not inspire optimism either (Janiszewska et al. 2009). In a separate comparative group (6-9 years old) to those studied in Czaplinek, six-year-old Radom children had faulty posture in 77.6%, in the posture of seven-year-old children faults occurred in 93.7%, in eight-year-olds 75.8%, while nine-year-olds did not have correct posture in 68.8%. Seven-year-old Radom children showed a clear breakdown (deterioration of posture) in their attitudes towards six-year-olds. A similar progression of faulty body posture was noted in children from Czaplinek. The most frequent postural abnormalities in children from Radom concerned scoliosis (73.9%) and defective shoulder blades (59.5%).

In the study of seven-year-old and fourteen-year-old children living in Lodz, which was conducted by *Olszewski et al.* (2007) in the group of seven-year-old children the body posture

defects were observed in 85% of girls and 90% of boys. The most frequent postural defects included improper shoulder, shoulder blades, abdomen and knee joints. In children of the same age from Czaplinek, postural defects were found in a smaller amount, i.e. 82% of girls and 78% of boys. Among the children from Czaplinek, the most affected by faulty posture were scoliotic attitude and scoliosis, which occurred in 41.7% of children, faulty feet (35% of children) and, similarly to the *Olszewski* study, the shoulder blades (42.7%) and knees (10.7%).

In Polkowice, the study was performed twice at six-year intervals on children aged 7-11 years (Cover et al. 2011). The results of the study show a tendency generation dependent body posture degeneration among children in the same age brackets. Among 7 to 9 years boys from Polkowice, during the first study, the correct posture was found in 81.5% of the subjects. In the second report, the percentage of boys with normal posture decreased to 80.3. In seven-year-old girls from Polkowice the percentage of normal posture increased from 66.4% to 74.6%. Among eight years old boys, the percentage of correct body posture decreased from 76.9% to 69.1%. Among eight-year-old girls, the decrease in the percentage of correct body posture was greater and amounted to 62.5% and 42.3% in the same periods. It is noticeable that 72% of boys aged nine had correct body posture in the first study and only 42.4% in the second study. The percentage of nine-year-old girls who defined by correct body posture was equal to 56.4%, and after six years, it decreased to 40.6%. The smallest differences between our results and those reported by Olszewski were found among seven-year-old children, both boys and girls. The greatest differences were observed for nine-year-olds of both genders.

In the study of six-year-old children from Warsaw (Makarczuk et al. 2005), posture defects occurred in 57% of girls and 65% of boys. Among the problems, flat feet were encompassed the highest percentage of the population and is equal to (70% in girls and 69% in boys. Lateral curvature of the spine was diagnosed in 13% of girls and 11% of boys. Other defects found in these children were: outliers and knee valgus, which accounted for 43% of all defects in the group of examined girls, in boys this percentage was46%.

In conclusion we note shyly that the characteristic attitude that most children currently represent is unfortunately a defective one.

Applications

The condition of the examined children's posture is similar to that in other regions of Poland. The quality of posture deteriorates at around 6 years of age and deteriorates in subsequent years of life.

Practical recommendations

Early detection of errors and posture defects is crucial in the process of effective postural re-education. Diagnosis of postural quality should be carried out frequently enough.

Compensation and corrective classes should be organized at school, especially for children in early childhood education.

The number of exercises that shape the habit of correct body posture - especially in the introductory and final parts - should be significantly increased in each physical education lesson.

In all "non-movement" school lessons, teachers should take care of the correct posture, especially the correct sitting position and use intracurricular exercises.

In the elimination of posture defects and their prevention, the best results can be achieved thanks to the comprehensive cooperation of parents, teachers and health care workers under the patronage of local authorities and school management - a commendable example of which is Czaplinek on the map of Poland.

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PREVENTIVE ACTIONS AGAINST COVID-19 AFTER PANDEMIC, DURING EPIDEMIC EMERGENCY

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Abstract

The coronavirus pandemic has significantly changed life, the perception of the world, modified the list of the most important values for humans putting health and life first. Pre-imposed orders, prohibitions, duties, rules of conduct transformed the previous life of society into a state of constant stress, frustration, fear for the lives of themselves and loved ones. For more than two years the pandemic managed to reorganize life and adapt to new rules of conduct and living or working conditions. Masks, gloves, keeping one's distance or disinfection became the norm in the prevention and fight against the SARS CoV-2 virus.

After the end of the pandemic was declared and a state of epidemic emergency was imposed, most of the restrictions were lifted or significantly reduced. The public is relieved, but still cautiously withdrawing from compliance with implemented and learned hygiene, safety rules. Cases of increasing incidence of Covid 19 confirm the fears of some scientists suggesting that the virus has been dormant, hidden, and in time will again spread and reshape the life of society around the world.

Introduction

History knows of at least several pandemics around the world. The development of civilization and the emergence of new, larger human populations caused numerous diseases that reached the name of epidemics and pandemics. Plague, cholera, typhoid, smallpox, syphilis, leprosy or Spanish flu sound like long-forgotten diseases that claimed thousands, millions of human lives.

The infamous history of selected pandemics is as follows:

Name of disease	Years of occurrence	Mortality rate
Antonine plague	years: 165-180	5 million deaths
Black Death	years: 1347-1351	25 million deaths
Smallpox	years: 1520-1979	56 million deaths
Great plague in London	years: 1665-1666	100,000 deaths
Spanish	years: 1918-1920	40-50 million (according to some sources even 100 million) deaths
Asian flu	years: 1957-1958	1-2 million deaths
Influenza Hong Kong	years: 1968-1970	1-4 million deaths
Russian flu	years: 1977-1978	1 million deaths
SARS	years: 2002-2003	800 deaths
Swine flu	years: 2009-2010	284,500 deaths
Ebola	years: 2014-2016	11,300 deaths
HIV/AIDS	years: 1981 - uncontrollable	35 million deaths
MERS	years: 2015 - uncontrollable	858 deaths
COVID-19	years: 2019 - uncontrollable	Infected worldwide 606,879,638 deaths worldwide 6,490,816 infected in Poland 6,173,059 deaths in Poland 117,059 (as of 30.08.2022)

(https://www.medicover.pl/about-health/history-of-pandemics-around-the-world-coronavirus-sars-cov-2-about-other-pandemics)

(https://www.worldometers.info/coronavirus/ (accessed:30.08.2022)

The hope for a reduction in the number of infections, a mild course of the disease that does not require hospitalization and the future disappearance of the virus have become vaccines and the gradual understanding of the infectious agent and how to prevent the spread of the disease.

Basic assumptions:

On March 11, 2020, the WHO declared the COVID-19 pandemic state, while in Poland the pandemic state has been in effect since March 20, 2020.

According to the definition provided by the World Health Organization (WHO), a pandemic is "the spread of a new disease throughout the world." The WHO indicates that the characteristics of the disease that favor the development of a pandemic are:

- low mortality of infected individuals
- high contagiousness
- long period of contagiousness, including contagiousness during the asymptomatic period of the disease, and
- lack of natural immunity

(https://onkologia.luxmed.pl/wp-content/uploads/2021/05/ Aware-in-pandemic.pdf**)**

On March 11, 2020, the WHO declared a COVID-19 pandemic state caused by the SARS CoV-2 virus, which has four structural proteins and its genome is single-stranded RNA (World Health Organization 2020; Wandtke et al. 2022). The first reports of cases of atypical pneumonia caused by an unknown pathogen, however, appeared as early as December 2019 and came from the city of Wuhan, capital of Hubei province in China (Hu et al. 2021). In early January 2020. The World Health Organization (WHO) began publishing data on cases of infection with the new strain of coronavirus (Nowakowska and Michalak 2020). In February 2020, a group of coronavirus researchers comprising the International Committee on Taxonomy of Viruses gave the new virus the name SARS-CoV-2 virus, and the disease resulting from SARS-CoV-2 infection was classified by WHO as COVID-19 (Zawilińska and Szostek 2020). When infected, the average incubation period is about 4-5 days before the first clinical symptoms appear, resulting in the spread of the virus from people who are unaware of their infection and transmit it through contact with others (Wlodarczyk 2020). Within 5-6 days of the onset of symptoms, the viral titer of SARS-CoV-2 reaches its peak - much earlier than in the case of SARS-CoV, where the peak viral load occurred around day 10 after the onset of symptoms, and then gradually decreases over 8 days (Michalski et al. 2020). Severe cases of COVID-19 often progress to Acute Respiratory Distress Syndrome - ARDS (World Health Organization 2020). Initially, SARS-CoV-2 infection manifests as fever, muscle pain and weakness, dry cough and shortness of breath, abnormal taste and smell, headache, and diarrhea, nausea and vomiting (Zahra et al. 2020; Swiatkowska et al. 2021).

In the majority of people infected with SARS-CoV-2, the disease is asymptomatic or sparsely symptomatic and mild, but about 14% of patients develop severe symptoms requiring hospitalization, and some patients have a very severe course of infection, often ending in death (Zhou et al. 2020). The most common severe or fatal course of COVID-19 occurs in the elderly, patients with concomitant diseases, including hypertension, diabetes, cardiovascular disease, chronic obstructive pulmonary disease, chronic kidney disease, cerebrovascular disease, HIV or hepatitis B virus infections, cancer, and those with impaired immune system function (Fang et al. 2020; Pawlowicz and Nowicki 2020; Sanders et al. 2020; Kruszewski 2021).

The numerous severe symptoms as well as the complications that remain after the illness significantly motivate and accelerate the decision among many people to be vaccinated against COVID-19 (Pinkas and Kicman 2020).

Diagnosis, prophylaxis in the form of COVID-19 vaccines have become important and effective ways to fight infection. Equally important were preventive measures to minimize the risk of transmission of the pathogen.

Proper health-promoting behavior, the use of personal protective equipment and strict adherence to epidemiological principles played a very important role. Disinfectant dispensers appeared permanently in medical facilities but also in stores, offices, railway stations, churches and many other places.

The decrease in the number of illnesses, deaths and hospitalizations due to coronavirus infections and the reduction in the number of people tested initially contributed to the gradual abandonment of the mandatory wearing of masks and gloves, and on May 16, 2022, the state of epidemic was lifted while the state of epidemic emergency took effect.

A state of epidemic emergency means that there is still a risk of an epidemic. The obligation to wear protective masks in medical entities and pharmacies still remains, medics still have to vaccinate against COVID-19, and covid certification still applies.

Habits acquired during the pandemic among the population have become the norm, such as, first of all: ■ frequent, thorough hand washing with soap and water (always when visibly soiled) and frequent hand sanitizing with a disinfectant based on at least a 60 percent alcohol solution; ■ avoiding touching the face, eyes, nose and mouth; ■ systematic washing and disinfecting of objects and surfaces; ■ Avoiding clusters of people, and if this is not possible, maintaining at least a two-meter social physical distance; ■ Avoiding close contact with people showing symptoms of respiratory diseases, observing hygiene rules when coughing and sneezing, i.e. covering the nose and mouth, preferably with a disposable handkerchief; ■ Wearing protective masks when in close proximity to other people (e.g. in a store, means of transportation or other enclosed space ■ sanitizing frequently touched surfaces in the workplace on a daily basis, such as doorknobs, worktops at workstations, desks, keyboards, sinks, toilets, soap dispensers and others; ■ providing employees with general access to skin sanitizers at the entrance to the workplace and in toilets in packs that do not require touching fingers (activated automatically, possibly with an elbow or forearm), as well as, if possible, agents e.g. sprays or disposable disinfectant-soaked wipes that employees can use on their own at their workstation before and after work ■ informing employees (via email or intra- or web-based platform, etc.) to stay at home in case of symptoms of respiratory tract infection, especially coughing, shortness of breath and fever (i.e., body temperature measured in the armpit fossa or on the forehead >38°C) until the symptoms have completely resolved (spontaneously, not under the influence of medication). (Socha 2020).

Also, health care facilities should specifically protect both patients and medical staff from the spread of the virus. Measures taken in medical facilities include: ■ Providing separate passageways (entrance, registration, waiting room, office) for patients presenting for preventive examinations in order to limit or even prevent contact with patients receiving other health services; ■ Measuring the body temperature of patients before entering the clinic, hospital or reaching the registration desk; ■ Limiting the waiting time in the waiting room for an appointment (max. 10 min) to reduce the time of potential exposure of the patient or medical staff to pathogens; ■ Increasing the time interval between patient admissions (≥20 min between scheduled appointments) to minimize their stay in the waiting room; ■ Providing offices where examinations are performed with a volume that allows staff and patient to be seated ≥2 m apart; the office should be ventilated frequently, the patient should be able to disinfect the skin of his or her hands before entering the office, and the doorknob should be disinfected each time the patient leaves; ■ filling out a health questionnaire before entering the clinic or office - in order to reduce the risk of virus transmission, it was recommended that the questionnaire be filled out with the patient's own pen, and if not, the pen should be disinfected after each use; ■ facing the patient's face away from the examiner when conducting chest auscultation or taking blood pressure, performing nursing and nursing procedures; ■ use of protective clothing (coveralls, barrier aprons), masks, visors, goggles, gloves by medical workers. (Rybarczyk-Szwajkowska et al. 2021; Karkowska et al. 2021).

The obligation to wear masks in health care facilities and pharmacies continues to be steadily extended.

The abolition of isolation and quarantine of people who are ill or leaving and returning from abroad has become a major convenience. Children have started schooling in residential settings. Most people also returned to their jobs.

Lockdown, remote teaching, and staying at home have not been indifferent to both physical and mental health. Diseases related to spinal degeneration have emerged, as well as a number of conditions caused by obesity, which has increased significantly among the public during the pandemic. This was caused by both staying constantly indoors, limited physical activity, and the closure of facilities such as health clubs and gyms. (Foster 2021).

Feelings of despondency, fear, uncertainty, depression were just some of the states that accompanied some people. They resulted in an unwillingness to perform basic daily activities. Some people did not feel the need to dress, wash, clean, cook. There have also been cases of suicide attempts and suicides. Mentally weak people were unable to cope with feelings of fear, loneliness, and isolation. (Petzold et al. 2020)

During the lifting of restrictions, the waiting time for a doctor's appointment, which was significantly extended during the pandemic, was shortened; online appointments caused dissatisfaction, anger among patients. Having to wait a long time for diagnosis, treatment in some patients caused them to give up and stop treatment. In other cases when the patient reported to the health care facility, the disease was already far advanced. Cancer, cardiovascular, pulmonary or nephrological diseases through lack of systematic treatment developed sometimes even leading to death.

Conclusion

The Coronavirus pandemic lasted nearly three years. We got to know the virus better, treatment became more and more effective, prevention was implemented. The above measures resulted in a downward trend of new cases. The epidemic began to move toward endemicity, i.e. the incidence of the disease in a given area in numbers that remained at a similar level for many years. Professor Pawel Grzesiowski described the current state of the epidemic threat with the words - " The war is on, the enemy has gone into hiding, but that doesn't mean it has stopped being dangerous." Despite the fact that society has begun to fight other new problems such as the war in Ukraine and the ecological disaster on the Oder River, the complications after contracting coronavirus, so varied and unexpected will more than once remind us of this dangerous virus that has dormant our vigilance for the time being.

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THE INTERVENTION OF ASSISTING PATIENTS TO SIT OVER THE EDGE OF THE BED - PRESENTATION OF AN OPTIMIZATION MODEL

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Abstract

Introduction: Health care workers show a large proportion of the occurrence of musculo-skeletal disorders due to physical stress at work and disregard of work ergonomics. The goal is to reduce workloads and thus preserve the health of employees. Methods: The purpose of our research is to show current or the most common version of the implementation of the intervention to help patients sit over the edge of the bed, and then present the optimization model. For this purpose, a biomechanical-ergonomical model has been created. Results: The optimization includes execution with as little lifting as possible or with stepwise execution and rotation of the center of gravity. Discussion: Taking into account the principles of ergonomics and biomechanics of movement, it is possible to achieve a lower physical load to the locomotor system of health care workers. At the same time, safety of the health care worker and the patient is ensured. Last but not least, our model includes greater activation of the patient and thus the achievement of higher independence and functionality of the patient. Conclusion: A modified version is recommended for patient mobility education curricula for health care workers.

Keywords: manual handling and lifting, ergonomics, biomechanics, body mechanics, health care workers

Introduction

Physical stress resulting from working with patients (handling and lifting activities) acts on the body and does not only depend on a single weight (mass) which is manipulated but also on the relative layout of objects, such as levers, forces and torque. It also involves the lifting technique adopted, for example the lifting strategy, positioning, muscle activity and physical condition (Cimolin et al., 2016; Haddas et al., 2016). Any manual handling and lifting increases the possibility of the risk of pain in the musculoskeletal system (Oliveira et al., 2015).

The term "correct lifting" is not new and has been used for more than 100 years; for example, already in 1898 Hampton (cited in Nelson (Nelson et al., 2007)) states that: "Occasionally, nurses complain that they hurt their back when moving the patient. This occurs because they haven't adequately performed lifting." Due to the nature of the work of health care workers they are among the ten occupations with the most work-related musculoskeletal disorders (MSD) (Bureau of Labor Statistics, 2015). Among health care workers and in the nursing profession in particular, there is a significant number of work-related musculoskeletal disorders, such as pain and injuries. There is evidence that a large number of the problems experienced by health care workers is linked to the cumulative effect of repetitive manual handling and lifting as well as working with inappropriate postures or approaches (Nelson et al., 2009). This can be attributed to the traditional model of educating health care workers about correct handling and lifting (Berman et al., 2021; Jacob et al., 2015; Rebec, 2021; Rees Doyle and McCutcheon, 2015). Patient transfers have been implicated as a contributing factor in the high work-related musculoskeletal disorder rate among health care workers (nurses), but surprisingly nurses spent less than 7% of their time during patient moving and transfer activities (Fiedler et al., 2012).

In the Standards of Nursing Activities, there is a section related to safe and efficient lifting techniques (Ivanuša and Železnik, 2008), which is not completely adequate for handling and lifting patients (Ravnik, 2014; Ravnik et al., 2017). Forces acting on the health care worker's spine during lifting can be so great that the best posture and body dynamics are insufficient to keep them from injury and the potential development of long-term back problems. It has been shown that ergonomically correct working can lead to a significant reduction in musculoskeletal load (Weißert-Horn et al., 2014). In many countries, mechanical movement and lifting are recommended or even required by legislation (Edlich et al., 2005). The approach that avoids unnecessary lifting has been proven to be highly effective in the prevention of musculoskeletal disorders (Nelson and Fragala, 2004).

In 2017 an innovative approach to the intervention to assist the patient to stand up was published (Ravnik et al., 2017). The basic condition was adequate pre-preparation of the patient and the health care worker. The correct implementation of the intervention enables the patient to be more active, which leads to better independence. Therefore, it is important that the first sitting is performed by physiotherapists who additionally test and physically prepare the patient. With the current research we want to expand the analysis of movement interventions, i.e. to do the same for the intervention of assisting during sitting.

Methods

The purpose of this research is to compare two different approaches to a single intervention of assisting patient to the sitting position (from supine) to reduce used forces and work-related musculoskeletal disorders. Nelson and Baptiste (Nelson and Baptiste 2004) summarized that the most commonly used approaches are ineffective in decreasing disorders. We highlight a single intervention of assisting a patient to the sitting position over the edge of the bed from supine. We suggest the importance of the basic work preparations (such as height of the bed), position of the person assisting (how to stand to perform an action), what instructions to give to the patient and how to perform the intervention.

Lifting a patient for the purpose of educating health care workers is still taught using traditional methods, which includes the standard approach of manual handling and lifting. Theory is designed for lifting objects with uniform shape and is not always easily applied to patients (Ravnik et al., 2017). When assisting a patient from supine to sitting over the edge of the bed, we can see the traditional approach (A section of Figure 1) (Rees Doyle and McCutcheon 2015; Berman, Snyder, and Frandsen 2021, Jacob, R, and Tarachand 2015) and the optimised or innovative approach (B section of Figure 1).

Before presenting both approaches graphically, we were interested in the actual state of use of each approach among students. We did an assessment of the frequency of implementation of an individual approach to the intervention of sitting among nursing students of the Faculty of Health Sciences in Izola, Slovenia. Before the students were introduced to the innovative approach, we were interested in how they would assist to sit the patient themselves. The data were observed during the course of rehabilitation in the last 5 years. Which approach did the students use most frequently – the traditional one (A section of Figure 1), its modification with the headboard bent by 25-40 degrees, or the novel approach presented in this article (B section of Figure 1).

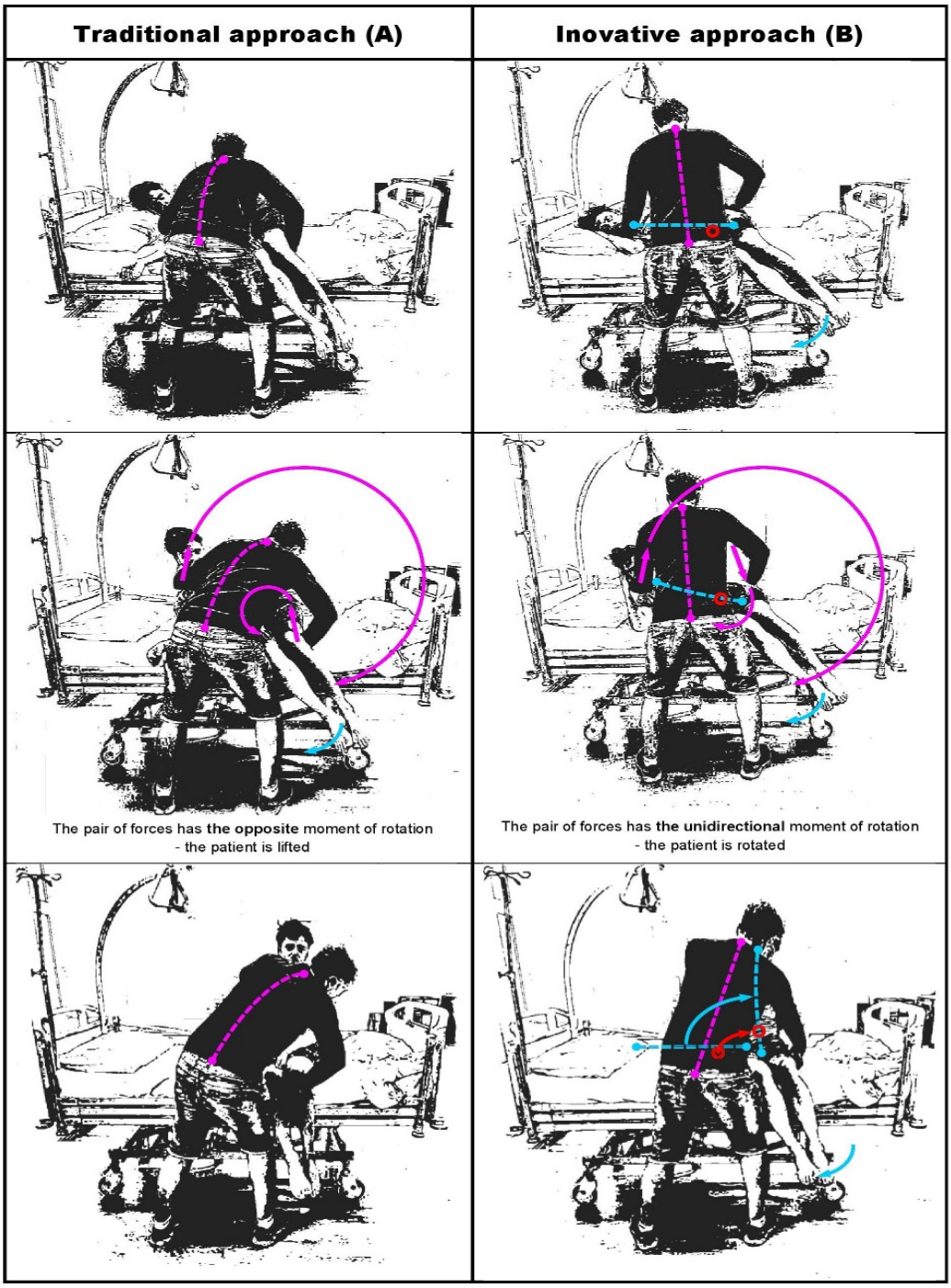

Fig. 1 Assisted patient transition from supine to sitting (Ergonomic analysis – biomechanical model)

Legend:

	- Axis of the therapist's axial system
	- The direction of the therapist's force (action) on the patient's body segments
	- Axis of the patient's axial system
	- Direction of movement of the patient's body segments (rotation and translation)
	- Approximate patient COG position
	- Direction of patient COG movement (rotation and translation)

Results

The results on the frequency of choosing the implementation of an individual approach to sitting are presented in Table 1.

Tab. 1 Method of implementation of sitting of nursing students (N=200)

Traditional way	Modified traditional way	Innovative approach
123	55	22
61.5%	27.5%	11%

The implementation of sitting with the innovative approach was carried out in only 11%, and among the participants there was no one who had not previously completed a medical high school programme (nursing assistant). All those who chose this approach were part-time students, that is those with some practical experience.

Comparison of transition from lying to sitting

The essential differences between the traditional approach and the innovative approach are shown in Table 2.

Tab. 2 Differences between approaches A and B

Feature	Traditional approach (A)	Innovative approach (B)
Health care worker		
Spine	forward / deviated / rotated	mostly straight leveled
Grip	under the legs and the latter are pulled and lifted over the edge of the bed	one hand under the shoulders, the other in the pelvic area
Pressure / force	simultaneously lifting the torso and lifting and pulling the legs over the edge. The pair of forces has **the opposite** moment of rotation - the patient is lifted	rotation of the COG by pressing the pelvis in the direction of rotation and a slight assistance in raising the trunk. The pair of forces has the unidirectional moment of rotation – the patient is rotated
Work in planes	simultaneously in the transverse and frontal	first in the transverse, then in the frontal
The center of attention	whole body	COG
Stability / balance	Medium	High
Consideration of ergonomics and safety	Medium	High
Patient		
Rotation to the side	passive (with the health care worker's help)	active (via a longer handle - a lever)
Legs over the edge	done by the health care worker	with bent legs, the higher leg pushes the one on the bed towards the edge
Trunk muscle activity	Medium	High
Consideration of independence and safety	Medium	High

Tab. 3 Argumentation for a different approach when assisting from supine to sitting

Argument	Question	Discussion
"Turn around independently or by turning with the lever over the knees and shoulders"	How do I achieve turning in bed with as little effort and as clear instructions as possible?	The lying patient bends his knees (this gives us a lever for rotating the pelvis to the side) and with one hand pulls the other arm towards the therapist (this gives us a lever for rotating the upper part of the torso)
"Put your feet over the edge of the bed"	How to get the weight of the legs to help when sitting down?	When lying on your side, the foot of the upper leg is behind the foot of the lower leg. When attempting to extend, the result is that both legs go over the edge and leverage is made
"Bed height"	At what height of the bed should I perform sitting?	As this is a difficulttask, the object of work (COG of the patient) must be kept at a height of 10-20 cm below elbow height
"Rotate the center of gravity (COG) of the load in the main direction – down – to the floor"	How do I achieve a trunk lift with as little lifting as possible?	By pressing down on the guttural crest, we achieve COG rotation, which initiates the lifting of the trunk into a sitting position, while at the same time slightly assisting the moment of force over the shoulders in the direction of sitting

Discussion

Given the high incidence of musculoskeletal disorders among health care workers, it would make sense to perform interventions that are ergonomically inadequate as slowly and deliberately as possible, whereby we should achieve that the patient himself helps us the most. Workers with a history of low back pain perform lifting with a style that is slower and more squat-like than workers without any history of low back pain (Saraceni et al., 2021). There are three main considerations when assisting patients with supine-sit transfers: maintaining the safety of the patient and health care workers; optimising the patient's mobility; and the use of a person-centred approach. It is important to ensure the correct biomechanics (Ravnik et al., 2017).

The conclusion we have drawn for the transition from the supine to the sitting position is that more can be achieved with the patient’s active involvement and the approach that involves minimum lifting by health care workers as well as the use of biomechanics (mainly rotation of COG). In this case we allow the patient to rotate COG, on the one hand, with the help of the

weight of their legs and, on the other hand, the activation of the trunk musculature as a result of the health care worker's pressure on the pelvis in the direction of the bed (Figure 1, section B). This is basically a lead-up to sitting up. To put it more simply, we can illustrate both approaches with the example of a pear, namely the so-called task of "*placing the pear in a position where the stem will be pointing upwards"*. Traditionalists would achieve this by lifting the pear by the stem (Figure 2 A), while innovators would achieve the same by pressing the pear's calyx (stamen) towards the ground (Figure 2 B). The former therefore lift, the latter push down. From an ergonomic point of view, the second approach is better. Two different directions of force action produce the same rotational effect.

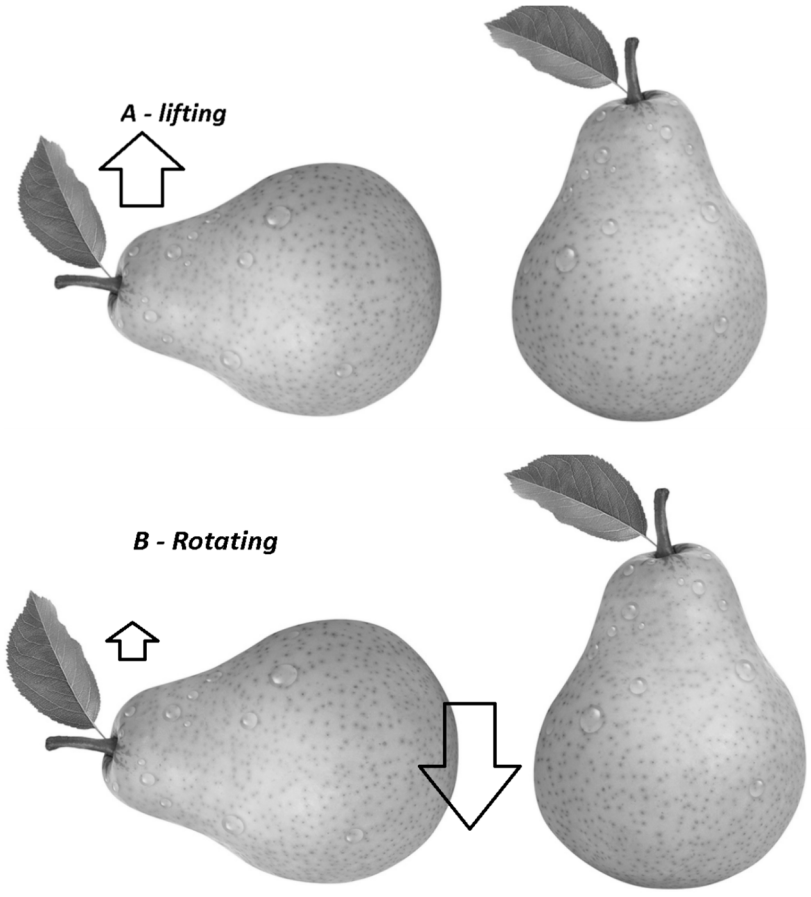

Fig. 2 Lifting or rotating - same effect

Sitting from a supine position is largely carried out without the use of devices. One of the traditional approaches is to raise the head of the bed 20 to 35 degrees or to use a pillow (Rebec, 2021). However, if our goal is to achieve patient's greater independence and physical fitness

with less handling and lifting, the innovative approach makes more sense, while being, at the same time, ergonomically and biomechanically more suitable (Ravnik et al., 2017).

All educational institutions at secondary and higher education levels should educate and prepare health care workers in the correct manual handling and lifting of their patients. Unfortunately, some students in this field continue to be taught traditional techniques, even though there is no evidence to support their use in practice. It has been known for some time that some are dangerous for the patient and the health care worker (Corlett et al., 1993). It is therefore necessary to reduce lifting and to apply evidence-based and scientifically proven biomechanical and ergonomical approaches. Our results indicate that pupils and students are taught to use the traditional approach, while individuals from practice (part-time students) already implement a different approach that is closer to our innovative one, either due to previous problems with movements or because of the inclusion of different approaches in education. As part of the education process, there is a need to establish good objective evaluation protocols, such as OWAS for physical stress measurement (Engels et al., 1998) or measurement of different body signs (Malikova et al., 2011), or to involve a multifaceted ergonomics program (Nelson et al., 2006). The introduction of obligatory study contents on ergonomics and safe working environments in health care settings is mandatory at all levels of education.

To make this a reality, health care managers should, together with physiotherapists and ergonomists, introduce special programs in the workplace, as well as identify how adjustments can be made to the patient's care environment. Thus we could start to address the problem experienced by many health care workers due to their limited knowledge, understanding and space to perform handling and lifting.

Conclusion

It is important to educate health care students at the beginning of their careers to ensure prevention of poor lifting techniques, thereby aiming to avoid injury. This may be partly achieved with minimizing manual lifting. It is clear that there is no safe way to manually lift. Even if a person is trained in "correct lifting", this will have no impact on the frequency of occurrence of musculoskeletal disorders (Martimo et al., 2008; Verbeek et al., 2011), because persons performing any kind of manual lifting are still exposed to danger. The role of the health care worker is, on the other hand, that of an enabler and assistant, not directly lifting the patient, but rather acting as a stabilizing member in the biomechanical chain patient - worker. Therefore our biomechanical analysis of the transition from lying to sitting is based on the comparison of the direction of forces and body mechanics. Despite all the research carried out and all the

evidence, traditional education on correct lifting remains a part of the education curriculum in nursing and other health care professions.

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SAFETY OF MOTHER AND NEWBORN DURING CHILDBIRTH

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Abstract

Introduction: The World Health Organisation defines the concept of patient safety as a framework of organised activities that reduce risks and the occurrence of harm. In relation to safe childbirth, FIGO states that no person (mother, newborn) should suffer a preventable death in relation to pregnancy, childbirth and the postpartum period. The World Health Organisation (WHO) recommends satisfying the needs of the mother, especially the needs of safety and security. More and more mothers evaluate their home as a safe environment and express their desire to give birth at home. Home birth is recommended only for healthy mothers with low risk.

The aim of the article is to describe safety in relation to childbirth, criteria for home birth, to find out the preference for home birth, women ´s opinion on the safety of home births and factors that influence a woman – mother when choosing the place of birth of her child.

Methods: A total of 105 female respondents between the ages of 18 and 40 took part in the survey. The majority of respondents were between the ages of 29 and 30. To collect data, we used a questionnaire of our own construction, which we distributed through social networks and discussion forums. We used simple statistical methods for evaluation.

Results: The maternity ward of a hospital is preferred by 62 (59.05%) women as the safest place for childbirth. As many as 24 (22.86%) respondents considered giving birth at home. The most common reasons why women refused to give birth in a healthcare facility were unnatural acceleration of labour / unwillingness to wait for spontaneous birth; hospital environment, „unequal“ communication between the woman and the medical staff / disrespect of the mother´s opinion. 21 women (25.61%) women chose to give birth at home. 87 (82.86%) respondents consider home birth to be dangerous, most often for the following reasons: „high risk of complications for the mother and the child“.18 (17.14%) of the interviewed women think that home birth does not mean a danger for the mother and the child. 98 women (93.33%) know the possible risks of home birth. Only 7 (6.67%) respondents do not know these risks. The choice

of the place of birth is influenced by the visit to the prenatal clinic and prenatal preparation courses.

Conclusion: It is the task of the entire gynaecological - obstetric community to prove that it is possible to give birth naturally and safely at the maternity ward of a hospital without unjustified routine interventions in childbirth, by respecting the birth wishes of mothers, by introducing the possibility of prenatal preparation in the home environment and the subsequent possibility of antenatal visit to the maternity ward of the hospital together with an accompanying person. However, this requires an amendment to the legislation.

Keywords: safety, home birth, midwife

Introduction

The World Health Organization (WHO) defines concept of patient safety as a framework of organised activities that create cultures, processes, procedures, behaviours, technologies and environments in healthcare that consistently and sustainably reduce risks, reduce the incidence of avoidable harm, reduce the probability of error and reduce its impact when it does occur.

FIGO states that in connection with pregnancy, childbirth and puerperium no person (mother, newborn) should suffer a preventable death, whether due to haemorrhage, infection, hypertension, complicated abortion / delivery or heart disease.

For this reason, WHO regularly issues and revises recommendations for safe childbirth. In 2016, WHO issued revised recommendations for prenatal care and in 2018 for care during childbirth to achieve a positive experience of pregnancy and childbirth. The new standard for safe childbirth contains 56 scientifically based recommendations on what care should be provided to the woman and child during and immediately after childbirth. The care is focused on the mother, on meeting her needs, especially the need for safety and security. Such a way of providing care supports the physiological processes necessary for a normal birth and leads to a reduction in the number of medical interventions. From this point of view, more and more mothers evaluate their home as a safe environment and express the wish to give birth at home. Certain rules apply to home birth. In addition to the desire to give birth at home, it is recommended only for healthy mothers with low risk, i.e., the women are healthy, the progress of pregnancy is physiological, without the need for pharmacological treatment, the child is in a head-long position, the woman has a spacious pelvis (Štromerová, 2015). Nevertheless, even an optimal progress of pregnancy does not guarantee a normal progress of childbirth. The

possibility of quick intervention in case of complications is guaranteed only by giving birth in a medical facility.

The aim of the article is to describe safety in relation to childbirth, criteria for home birth, to find out the preference for home birth, women ´s opinion on the safety of home births and factors that influence a woman – mother when choosing the place of birth of her child.

File, methodology

A total of 105 female respondents between the ages of 18 and 40 took part in the survey. The majority of respondents were between the ages of 29 and 30. The representation of other age groups is shown in Figure 1. At the time of the survey 47.62% were pregnant and 52.38% were not pregnant, 78.10% of respondents had already given birth.

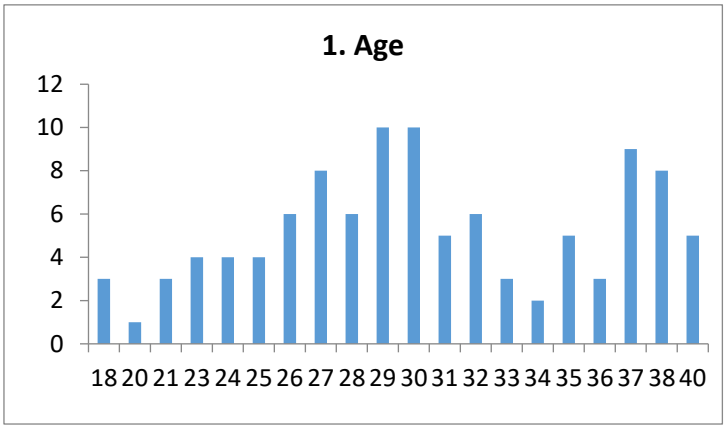

Fig. 1 Age

To collect data, we used a questionnaire of our own construction, which we administered on social networks and in discussion groups. The questionnaire consisted of open and closed questions divided into three areas in the context of the research objectives. Respondents had the opportunity to further propagate the questionnaire by copying and sharing the internet link of the questionnaire. We processed the data through simple statistics.

Results and discussion

We investigated the preference for home births in the Slovak Republic. 62 (59.05%) of the interviewed women still prefer the maternity ward of the hospital as the most ideal place for giving birth. Fewer respondents answered that they would choose the option of a private

maternity hospital, or a private maternity clinic 11 (10.48%). In the open answers, women most often stated the reason for giving birth in a maternity ward: „the safest place for giving birth; supervision of experts over the process of childbirth; possibility of administration of epidural analgesia, painkillers; clean environment, sterile tools; treatment of the newborn after birth; possibility of bonding; ensured health status of the child; financial simplicity".

As many as 24 (22.86%) respondents considered giving birth at home. The most frequent reasons why women refused to give birth in a medical facility were: „unnatural acceleration of delivery / unwillingness to wait for spontaneous childbirth; the hospital environment, the rooms of the maternity ward are outdated, uncomfortable and not cosy; limited movement during childbirth, the impossibility of choosing a position during the second stage of labour, poor support for alternative methods of reducing labour pain; inappropriate approach of the healthcare staff, „unequal" communication between the woman and the medical staff / disrespect of the mother´s opinion – psychological pressure – unwillingness to listen to the mother and consult her idea of childbirth or birth plan; frequent medical and pharmacological intervention in the physiological progress of childbirth; failure to provide sufficient information on child and woman care; poor breastfeeding support; limited contact with the child, bonding is not supported, lack of privacy after childbirth; the presence of an accompanying person for a fee". The possibility of giving birth in a maternity home was the least represented by 8 (7.62%), probably because no maternity home has been established in Slovakia.

We were also interested in whether the women gave birth at home and opinions on the safety of home birth**.** 61 respondents (74.39%) stated that they had never given birth at home, however, some women stated in the note that they are thinking about the possibility of home birth in the future. 21 women (25.61%) chose to give birth at home. All women reported that it was a pre-planned home birth. In neither case was it an urgent situation. Next, we investigated opinions on the safety of home birth. 87 (82.86%) respondents consider home birth to be dangerous, most often for the following reasons: „ high risk of complications for mother and child; even if the pregnancy proceeds without complications, there is the possibility of complications during childbirth; absence of professional staff (several); unavailability of painkillers, epidural analgesia...; deficiencies in environmental hygiene; more demanding transfer to a medical facility in case of complications; the rapid arrival of ambulance is questionable; in case of complications, the impossibility of performing an acute caesarean section or other obstetric surgery". 18 (17.14%) of the interviewed women think that home birth does not mean a danger for the mother and the child. In the note, some women expressed the opinion that giving birth at the maternity ward of a hospital is as dangerous as giving birth at home.

From the point of view of choosing the place of birth, it is also important to be aware of the risks of home birth.

98 women (93.33%) know the possible risks of home birth. Only 7 (6.67%) respondents do not know the risks. Those women who know the risks of home birth were also able to identify specific risks of home birth: the most common complication reported by mothers during home birth was acute hypoxia of the foetus due to compression of the umbilical cord during its collapse, as well as a wrapped umbilical cord around the neck and body. In one case it was the right node on the umbilical cord. One of the mothers decided to give birth at home to a child who was in a breech position, and in this case the complication of the child´s entrapment in the birth canal occurred. In several other cases, respondents mentioned aspiration of meconium as a complication. Furthermore, there was the risk of maternal bleeding, the risk of complications of the newborn´s health during and after childbirth.

The choice of the place of birth can be influenced by a visit to the prenatal clinic and prenatal preparation courses. In the prenatal consultation, women can learn more about their health and also about the condition of the child, which can significantly influence the decision-making process of the mother. The answers show that up to 91 (93.81%) women are subject to monitoring their pregnancy, their health and the health of their child. Women who did not visit antenatal clinic 6 (6.19%), stated in the note that they either did not visit prenatal clinic regularly or chose a purely alternative course of their pregnancy without any monitoring in prenatal clinic. Despite the low number of women who do not regularly visit antenatal clinics, there is a risk of neglecting health care for the mother and the child, which may represent the first of the potential risks if a woman decides to give birth at home.

In the same way, the absence of visits to psychophysical preparation courses for childbirth can influence a woman when deciding on the place of birth. Women, especially primiparous / first-time mothers, do not have a sufficient idea of how childbirth takes place. That is why they are often affected by e.g., various discussion forums, which mostly offer distorted ideas about childbirth, and they do not receive information about the real course of childbirth and the possibilities of its management. These can force them to think about a home birth, which they will manage according to their own ideas. Perhaps a series of visits to a course of psychophysical preparation for childbirth would be enough so that women are informed about their rights and obligations, about their options (e.g., working with pain), techniques and exercises during childbirth, which will enable them to experience childbirth as a beautiful moment even in the hospital environment. Data analysis show that 52 (53.61%) women did not complete the PPP (psychophysical preparation) course for childbirth. 31 women (31.96%) said

that they completed PPP course for childbirth. The most frequent answer of women who marked the option „other“ in the questionnaire, 14 (14.43%), stated that they did not know what course it was, or that they prepared for childbirth individually (literature, information from the Internet, advice from women who had already given birth at home etc.)

The midwife is an important source of information for women, women value the opinion of the midwife and significantly influence the woman in her decision. The importance of the position of the midwifery profession in European countries is also stated by Lazorová 2014: „In some countries, e.g., in the Netherlands, 70-75% of births are led by a midwife, ratio of midwifery care provided at home (in non-hospital environment) and in the hospital environment is about 30:70“ (Lazorová, 2014). The Nordic countries also have the same percentage representation of births managed by midwives.

Discussion: The safety of the woman and of the newborn during home birth is a discussed topic. Among the largest international studies published by the International Journal of Obstetrics & Gynaecology is a meta-analysis that compared more than 500,000 home and hospital births in different countries around the world. It points to the fact that planned home births were associated with fewer medical interventions, including epidural analgesia, electronic foetal monitoring, episiotomy, etc. These women were also noted to have a lower risk of infection and life-threatening bleeding after delivery. Although planned home and hospital births showed similar results, planned home births were associated with significantly higher neonatal mortality (AJOG, 2010; Nejezchlebová,2010).

A Dutch study of 321,307 home births from 2009, in women with low-risk anamnestic data, who attended antenatal clinics during pregnancy, reports minimal differences in intrapartum and postpartum neonatal mortality between home and hospital births. In the discussion part of the work, the authors present the opinion that planning a home birth is a safe option in a country with a developed maternity care system. They also point to the need for enough well-trained midwives who will assess the suitability of birth at home with regard to rapid transport and an integrated system of follow-up care (BJOG,2009).

Another study was carried out under the auspices of the National Institute for Health Research (NIHR) and the department of the research program for health policy, between 2007 and 2010, in Great Britain. Approximately 65,000 births were included in it. For „ low-risk“ women, the incidence of adverse complications during childbirth (mortality of the mother and child during delivery, early death of the newborn, neonatal encephalopathy, meconium aspiration syndrome, birth injuries, ...) was very low (4.3 events per 1000 births). The attribute the great importance of these positive results mainly to the existing maternity wards led by midwives, which

represent a kind of alternative health care option that is safe for both mother and child. For primiparas / first-time mothers, it represents a 9.3% risk of complications per 1,000 planned home births compared to a 5.3% risk per 1,000 births in maternity units. In multiparous women, no significant differences were noted between births at home and births in a medical facility in connection with the occurrence of an acute complication. The need for episiotomy and the use of medication during childbirth was even lower (NPEU, 2017). Here, however, it should be noted that only mothers with a physiological course of pregnancy were included in the research, i.e. women who were assumed to have a low risk of complications during childbirth. Mary Newburn from the National Childbirth Trust claims that this study should be authoritative for the establishment of new maternity facilities outside the hospital environment (ČTK, 2011). „This is also supported by gynaecologists-obstetricians, but only in the case of maternity homes within hospitals, were it would be possible to immediately provide professional medical care to the mother in case of complications“ (ČTK, 2011).

A study by The American College of Obstetricians and Gynaecologists talks about the necessity of tightening the selection of suitable adepts for a planned home birth. The overall risk of infant death was significantly higher for planned home births (12.1 infant deaths per 10,000 births) compared to hospital births led by midwives (3.8 infant deaths per 10,000 births) or physicians (5.09 infant deaths per 10,000 births). Neonatal mortality was significantly increased in planned home births with the following risk factors: breech position (127.52 deaths per 10,000 births), primiparous women (22.5 deaths per 10,000 births) and previous caesarean section (18.91 deaths per 10,000 births). The risk of neonatal mortality was also increased if the expectant mother was over 35 years of age (AJOG, 2017).

Lazorová states that „ midwives in Slovakia are not allowed to assist a woman during a home birth. We do not have set conditions for management of a home birth, we do not have a list of equipment for home birth, and we do not have a list of procedures for home birth. In case of complications, we do not have defined procedures and we cannot administer basic medications“ (Lazorová, 2014).

Conclusion

A planned home birth is safe for women with a low-risk pregnancy and a physiological course of labour. Due to the fact that the birth process is influenced by a large number of factors, many complications can arise that threaten the health and life of the woman and the newborn. For their safety, it is the task of the entire gynaecological-obstetric community to prove that it is

possible to give birth naturally and safely in the maternity ward of a hospital without unjustified routine interventions in childbirth, by respecting of the birth wishes of mothers, by introducing the possibility of antenatal preparation in the home environment and the subsequent possibility of an antenatal visit to the maternity ward together with the accompanying person. The amendment of the legislation and its setting, which would suit mothers, but also midwives and obstetricians and ensure physical and psychological health for mothers and newborns, is a challenge not only for health professionals but also for the entire health care provision system in Slovakia.

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ANALYSIS OF THE FREQUENCY OF FOCAL LIVER LESIONS IN YOUNG ADULTS

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Abstract

Focal liver lesions are an increasingly common diagnostic and therapeutic problem in the world. Liver diseases are detected and diagnosed more and more often thanks to the growing popularity of many imaging tests, such as ultrasound, computed tomography or magnetic resonance imaging. The main aim of the study was to assess the frequency of focal lesions in the liver in adults under 40 years of age and create a list of the most common changes diagnosed. The materials for the study were histopathological results and medical history of patients under 40 years of age with focal lesions of the liver treated surgically in the Department of General Transplantation and Liver Surgery of the Medical University of Warsaw and diagnosed in the Department of Pathomorphology of the Medical University of Warsaw during the period 2002-2012, patients admission books of the Department of General, Transplant and Liver Surgery Medical University of Warsaw during the period 2010-2012. The most frequently diagnosed focal lesions in the group were hepatic metastases, then focal nodular hyperplasia, and the least common lesion hepatocellular carcinoma. Focal changes of the liver are almost twice as frequent in women. In the group of young adults, focal liver lesions are present almost 10 times less often than in the group of patients over 40 years of age. Patients with focal liver lesion under 40 were more often treated with surgery compared to patients over 40 years of age.

Keywords: liver, focal lesions, young adults

Introduction

Liver diseases are detected and diagnosed more and more often thanks to the growing popularity of many imaging tests, such as ultrasound, computed tomography or magnetic resonance imaging. According to the National Cancer Registry, malignant neoplasms are the second cause of death in 2019, causing 25.7% of deaths in men and 23.2% of deaths in the group of women in Poland. Importantly, they constitute a significant problem, especially in the group of ever

younger patients (25-64 years old). This phenomenon is visible mostly in the population of young women. In the group of young patients, the percentage of deaths due to malignant neoplasms was 31.7%, while in middle-aged women it was 46.8%. The detection of a focal liver lesion in at an early age prompts consulting doctors to act quickly and efficiently in order to diagnose the nature of the lesion correctly and initiate an appropriate treatment regimen. [Harrison et al 2012; Kordek et al 2013; Krawczyk et al 2015; Yamada et al 2010; Wojciechowska et al 2019]. The incidence of liver tumors depends on the geographic region, the age of the patient, and gender. In the group of adults living in Western countries, metastatic changes to the liver, mainly from the large intestine, are observed most often. Primary focal lesions of the liver are mainly found in the group of people living in Africa and the Far East [Bosman et al 2010; Domagała 2010; Porro et al 2013]. Liver tumors are characterized by a wide variety of morphological structures, which sometimes cause diagnostic problems. In recent years, pathologists have been drawing more and more attention to cancers of a mixed nature, referred to as the so-called combined hepatocellular-cholangiocellular carcinoma (cHCC-CCC). Focal liver lesions can be divided into non-neoplastic (inflammatory, hamartomatic, focal nodular hyperplasia, cysts) and neoplastic changes. These changes can also be classified based on the results of imaging diagnostics (we talk about cystic or solid lesions); or depending on the histological structure (derived from the hepatic cell, biliary epithelium or other structural elements of the liver) [Bosman et al 2010; Domagała et al 2010; Kordek et al 2013; Netter et al 2010; Szparecki et al 2016]. Neoplastic changes in the liver can also be classified according to nature of the growth (benign and malignant). Malignant lesions can, in turn, be classified as primary or metastatic [Domagała et al 2010; Kordek 2013; Krawczyk et al 2015; Netter et al 2010; Szczeklik 2005]. The work systematizes the most common focal liver lesions in young adults and analyzes the frequency of lesions treated surgically and conservatively.

Work objectives

As mentioned in the introduction, malignant liver tumors are mainly present in people over 60 years of age. However, in clinical practice, such changes are observed more and more frequently in younger people, under 40 years of age. They cause many problems in the differential diagnosis of focal liver lesions. Some motions have been presented in the work:

1. Assess the frequency of focal changes in the liver in adults under 40 years of age;
2. Create a list of the most common focal liver lesions in the group of operated young adults;

3. Analyze the percentage of patients treated by the means of a surgery and conservatively.

Materials and methods

The materials for the work included:

- patients admission books from the Department of General, Transplant and Liver Surgery of the Medical University of Warsaw in the period 2010-2012 to check the actual percentage of patients under 40 with focal liver lesions (including conservatively treated patients).
- results of histopathological examinations of patients under 40 with a focal liver lesion treated surgically in the Department of General, Transplant and Liver Surgery Medical University of Warsaw and diagnosed in the Department of Pathomorphology Medical University of Warsaw in 2002-2012.

Results

As it has been mentioned in the introduction, focal liver lesions (both primary and metastatic) occur mainly in the elderly. These changes are detected in the patients below 40 years of age constitute a significant diagnostic and therapeutic problem. In order to assess the scale of the occurance, the books of admission of patients treated in the Department of General, Transplant and Liver Surgery in 2010-2012 were analyzed. During this period, 2477 patients were admitted with a focal liver lesion included in the diagnosis, which accounted for 27% of all admissions. They were mostly patients over 40 years of age (92% of all patients with focal liver lesions 2281 people). There were 196 young adults, i.e., patients under 40 years of age, admitted for focal liver lesions in 2010-2012, which corresponded to 8% (Figure 1).

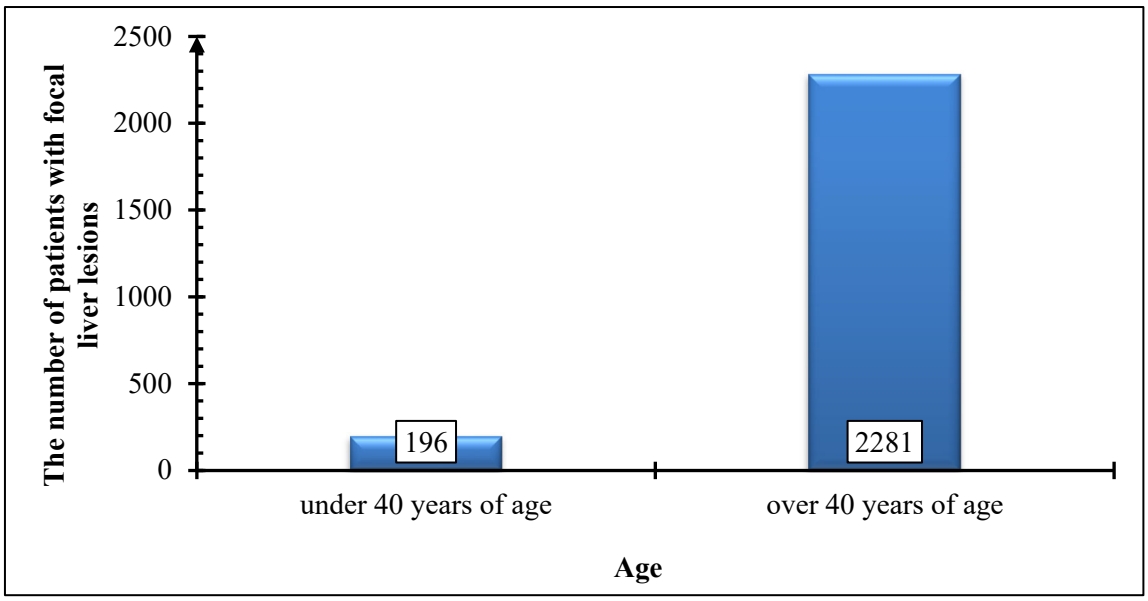

Fig. 1 The number of patients with focal liver lesion admitted in 2010-2012 according to age

Patients with focal lesions were treated conservatively or surgically, depending on their clinical status. Surgical patients were diagnosed in the Department of Pathomorphology Medical University of Warsaw. In the group of surgically treated patients over 40 years of age with focal liver lesion were 1201 (52%), while those treated conservatively accounted for 48% (1080 people). 116 patients under 40 years of age were treated surgically (60% of them), while 80, which constituted 40%, conservatively (Figure 2).

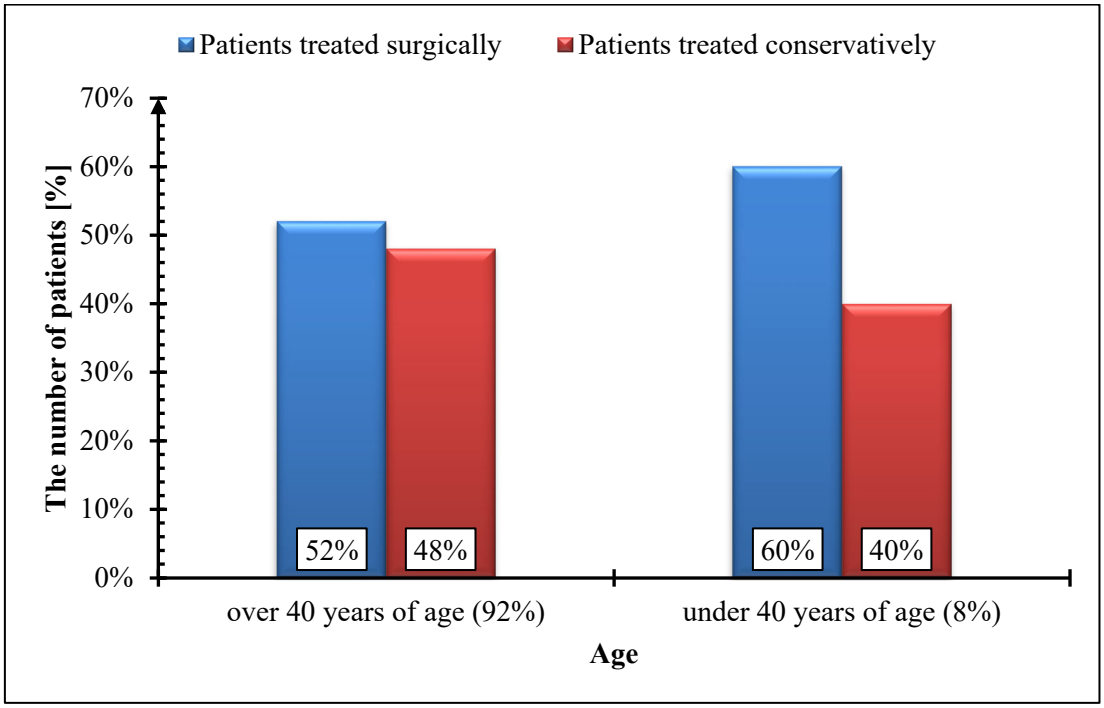

Fig. 2 Methods of treating patients with a focal liver lesion in 2010-2012

In order to check the types of histopathological changes diagnosed in adults under 40, an analysis of the histopathological diagnoses in patients operated in the Department of General, Transplant and Liver Surgery Medical University of Warsaw during 11 years from 2002 to 2012 was performed. In the years 2002-2012, in the Department of Pathomorphology, a total of 3396 focal lesions in the liver were diagnosed of which 344 lesions (10%) were diagnosed in 337 patients under 40 years of age (Figure 3).

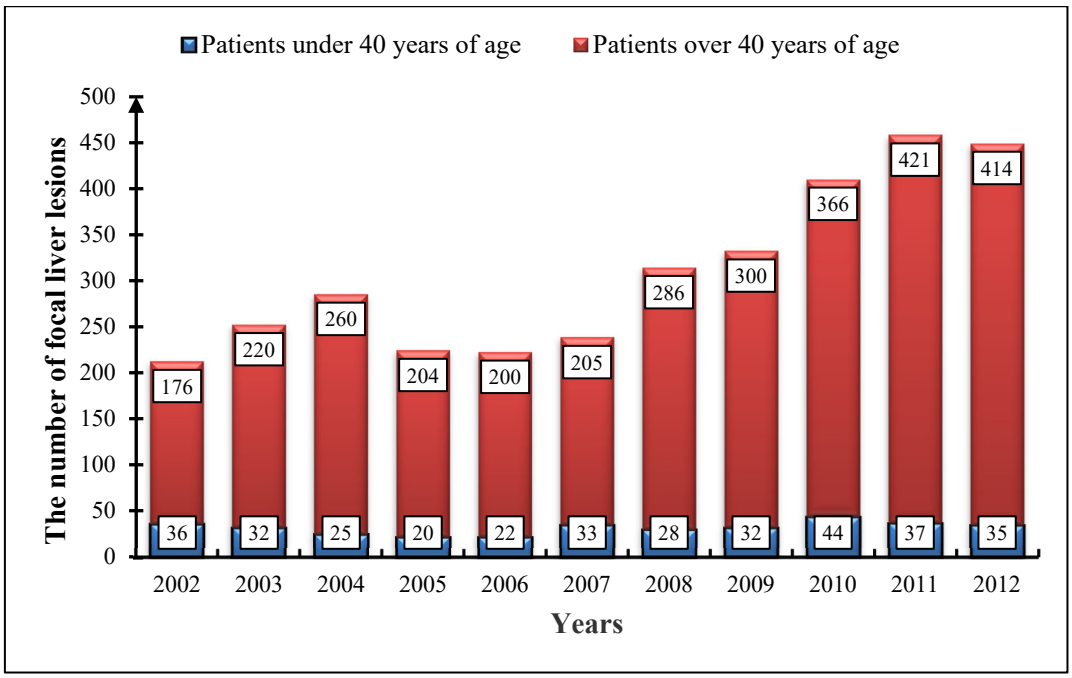

Fig. 3 Diagnosed number of all focal liver lesions in 2002-2012 according to age

Over the 11 years, there has been a noticeable decrease in the number of people under 40 undergoing surgeries compared to all those operated on (the highest percentage was 20.5% in 2002, the lowest 8.5% in 2012). The percentage of focal changes in people under 40 over these years is presented in Figure 4.

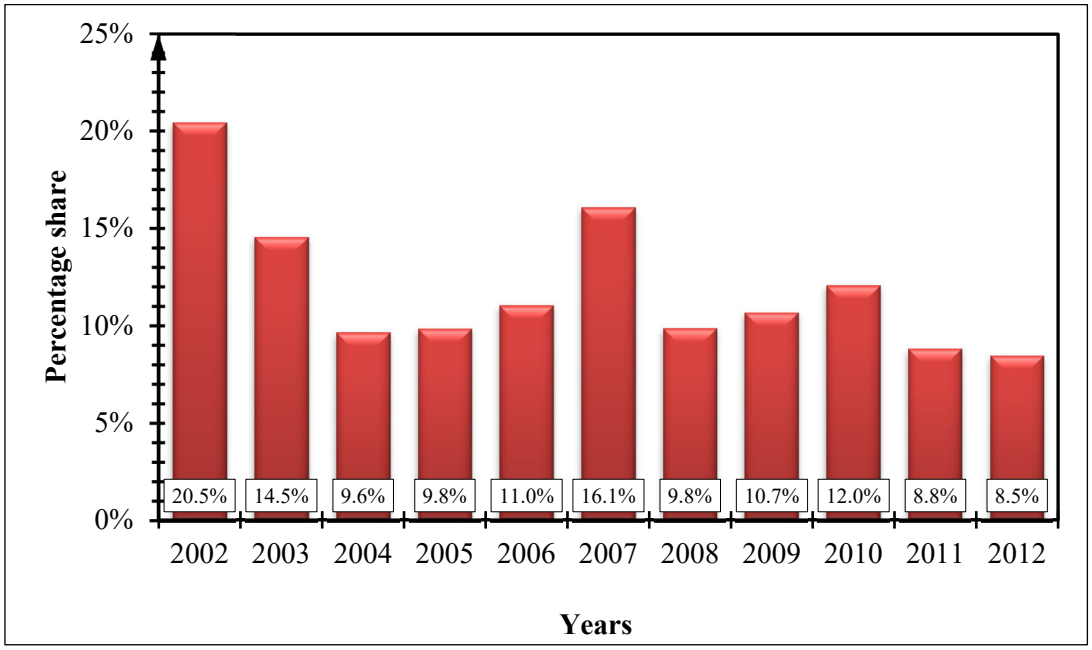

Fig. 4 Percentage of operated focal liver lesions in young adults in relation to patients over 40

The most frequently diagnosed focal liver lesion within 11 years in the group of patients under 40 were: tumor metastasis in the liver, focal nodular hyperplasia (FNH) and hepatocellular carcinoma (HCC) in the third place (Figure 5).

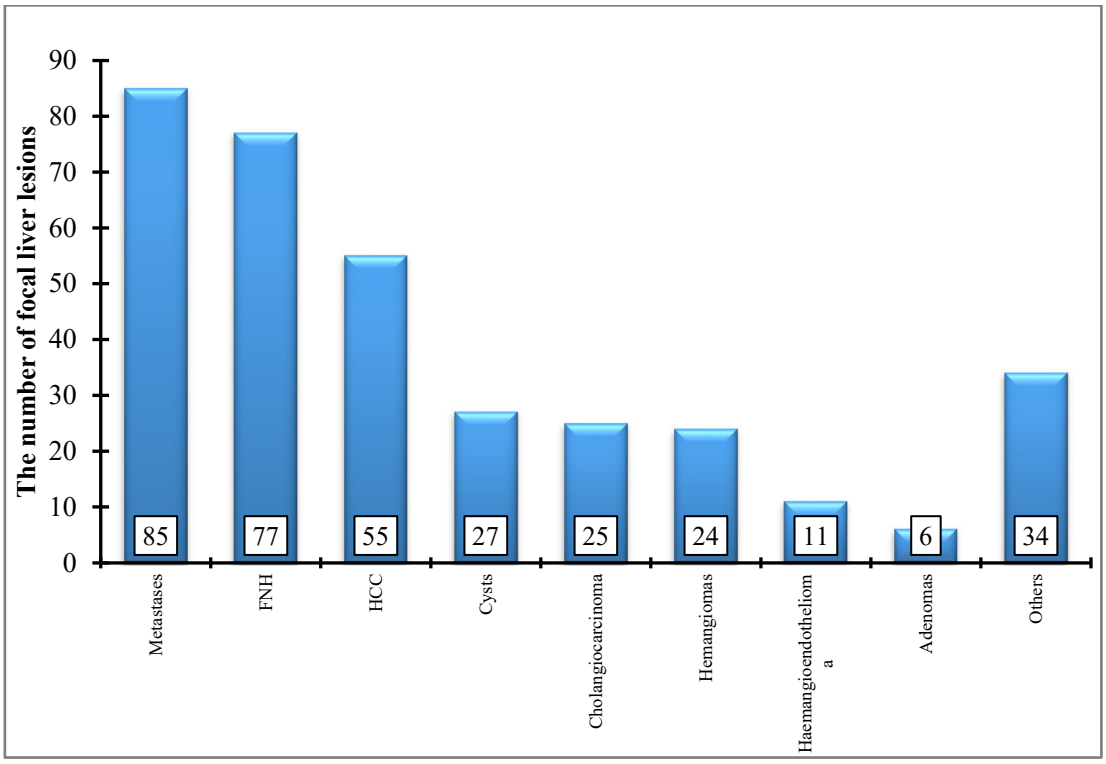

Fig. 5 The most frequently diagnosed focal liver lesions in young adults

Among 337 patients under 40 with diagnosed focal liver lesion, almost 2/3 were women 64% (214 people), while men constituted only 36% of the entire study group (123 people).

Discussion

Focal liver lesions are an increasingly common diagnostic and therapeutic problem in the world. According to the World Health Organization, the most common primary malignant liver lesion, hepatocellular carcinoma in terms of mortality, ranks third among all malignant neoplasms on a global scale. Undeniably, the number of patients with hepatocellular carcinoma is constantly increasing. It is most common in the group of patients between 50 and 75 years of age. However, in recent years the attention of many authors has been drawn to the problem of hepatocellular carcinoma and focal liver lesions in the group of ever younger patients [Habior; Krawczyk et al 2015; Takeishi et al 2011; Wojciechowska et al 2019]. A similar topic of the presence of focal liver lesions was discussed by Laiq Z. who, together with his team, determined

the frequency of these lesions in adolescents and children. He conducted an 18-year retrospective review of focal liver lesions in patients hospitalized at John Hopkins Hospital in Baltimore. The analyzed work presents 40 cases diagnosed by fine needle biopsy; 60% of the lesions turned out to be neoplastic, 25% non-neoplastic and 15% atypical lesions difficult to be clearly assessed in fine needle biopsy. Among neoplasms as much as 88% were malignant, with the most metastases, followed by hepatocellular carcinoma. Among the non-neoplastic changes, FNH was the most frequently diagnosed. Moreover, during a thorough analysis of atypical lesions, 2 of them turned out to be hepatocellular carcinoma. All changes were more common in children and female adolescents [Laiq et al 2012]. A different theory was put forward by Naganuma H. and his colleagues, who also conducted studies on focal nodular hyperplasia. Their research group consisted of 53 people with FNH between 30 and 60 years of age from Japan. They concluded that FNH is more common in men living in Asian countries compared to reports from European countries where FNH is more often diagnosed in women. Moreover, they found that in the studied group metabolic diseases coexisted more often in men than in women [Naganuma et al 2017].

Another research problem was to determine whether diagnosed hepatocellular carcinoma in young people has a better prognosis. German scientists have come to this conclusion. Niederle IM. and his colleagues from the Clinic of the University Hospital in Mainz compared a group of young adults with a group of people over 40 who had been diagnosed with hepatocellular carcinoma. They concluded that hepatocellular carcinoma is a rare cancer in people under 40 in countries where there is no endemic increased incidence of hepatitis B. This, in turn, is manifested by a reduced incidence of chronic liver disease and a longer duration of disease. overall survival in contrast to patients living in Asian countries [Niederle et al 2012].
In my work, I analyzed only a group of young patients in detail with focal lesions in the liver, and I did not compare the survival with the group of patients in old age. Probably the age of diagnosis is an important prognostic factor in various neoplasms. In the course of breast or stomach cancer, young patients have a much worse prognosis. The situation is different in the case of thyroid and colorectal cancers, where young patients have a better prognosis. In the case of hepatocellular carcinoma, the authors' opinions are divided.

Conclusion

1. In the group of young adults, focal liver lesions are present almost 10 times less often than in the group of patients over 40 years of age.
2. Focal changes of the liver in adult patients under 40 are almost twice as frequent in women.

3. Patients with focal liver lesion under 40 years of age were more often treated with surgery compared to patients over 40 years of age.
4. Over 11 years there has been a decline in the number of operated young adults.
5. Among malignant neoplasms in the group of patients under 40, the most common were metastases of the malignant neoplasm to the liver (most often colorectal cancer), hepatocellular carcinoma was placed second.
6. Focal nodular hyperplasia (FNH) was the most frequently diagnosed among non-neoplastic liver lesions. In the study group, this change was more frequent than hepatocellular carcinoma.

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CRITERIA FOR EXPERTS IN NURSING VALIDATION STUDIES IN THE SLOVAK REPUBLIC

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Abstract

Introduction: Validation studies are used for the development of nursing science, mainly to improve the classifications of diagnoses, interventions, and outcomes. Objective: To find out meeting the expert selection criteria for research on content and clinical validation of nursing diagnoses, outcomes, and interventions in the Slovak Republic, and evaluate their relevance and validity. Methods: A cross-sectional study was used. A total of 435 nurses were rated. The data was collected with the use of the self-administered questionnaire that rated the recommended criteria for experts for validations in nursing. The IBM SPSS 24.0 statistical programme, simple descriptive statistics were used for data analysis. The study was approved by the Ethics Committee. Results: Master's education in nursing as one of the recommended basic criteria for experts in nursing is met by 20 % of the addressed respondents – nurses. According to the adapted national criteria in the SR, where the criterion of Master's education is not a condition in the present, the criterion for an expert is met by 90.6 % of the nurses. Conclusions: Given the growing need to conduct validation studies for classifications of diagnoses, interventions, and outcomes, in each country it is necessary to reduce uncertainties, difficulties, and limitations of expert selection criteria.

Keywords: nursing, diagnosis, intervention, outcome, expert

Introduction

Validation studies are used for the development of nursing science. The concept of validation is one of the significant terms in methodology for research on the diagnostic categories – nursing diagnoses in nursing (Mazalová, Marečková, 2012), and nursing interventions and outcomes.

Validation of a nursing diagnosis consists of providing evidence that a group of defining characteristics related to the diagnosis really occurs as a unit (whole) in clinical situations (Gordon, Sweeney, 1979; Fehring, 1986). Validation of a nursing diagnosis involves examining whether all important diagnostic signs (defining characteristics and related factors) are represented in the nursing diagnosis (Creason, 2004). Validation of a nursing diagnosis focuses on enhancing the accuracy of nursing diagnostics and standardisation of nursing terminology (Zeleníková, Žiaková, 2010). Gordon and Sweeney (Creason, 2004) are considered to be the main pioneers of methodology for research validation of nursing diagnoses. They proposed three models for identification and validation of nursing diagnoses: the retrospective identification model, the clinical model, and the nurse-validation model. Another significant expert is Fehring (1994), who described more detailed methodology for validation of nursing diagnoses. He defined five models for validation of nursing diagnoses: the Diagnostic Content Validity (DCV) Model; the Clinical Diagnostic Validity (CDV) Model; the Etiologic Correlational Ratings (ECR); the Patient-Focused CDV Model; and the Differential Diagnostic Validation (DDV) Model (Fehring, 1994).

Other approaches in validation of nursing diagnoses are presented by Hoskins (1997); validation methodology uses direct observations of patient's behaviour as a source of information to set a diagnosis. The information is collected through the nurse-patient interaction or recorded data obtained from documentation. The author describes three phases of the validation process of nursing diagnoses: conceptual analysis, validation by experts, and clinical validation.

A four-phase validation process of nursing diagnoses is described by Grant, Kinney and Guzzetta (1990). The first phase includes identification of defining characteristics and operational definitions for a specific nursing diagnosis. The second phase includes identifying major defining characteristics using the estimation scaling. The third phase includes rating of defining characteristics by patients in clinical environment. In the fourth phase the nursing diagnosis is rated to determine its efficiency in the selection of nursing interventions and setting patient outcomes.

The concept of validation is also used in the context of verification of nursing interventions. Similarly, the Fehring's models (Fehring, 1986), including DCV and CDV, are used. The methodology of the models has been adapted for the use for verification of nursing interventions and has offered an Intervention Content Validity (ICV) score with critical (major) and supportive (minor) activities (Bulechek, McCloskey, 1992).
Results of validation studies are essential for enhancement of classifications of diagnoses, interventions, and outcomes (Teixeira et al., 2011; Cavalcante et al., 2013; Zeleníková et al., 2014).

In the studies that validate the content of standardised nursing languages, experts must know a phenomenon they study to rate its representativeness (typicality) or relevance.

A key issue in the validation process is expert selection. An expert in any area is characterised by higher education, excellent performance, and more than 10-15 years of highly motivated intensive work in a specific area (Jones, 2008). For the purposes of nursing diagnostics, the need of "real" experts has been emphasised. Galdeano and Rossi (2006), the Brazilian researchers, recommend precision and responsibility in expert selection, and emphasise the need to define a nurse expert as a person with extensive knowledge and skills based on research and clinical practice.

According to Fehring (1994), the minimum criterion for a nurse – expert is Master's education and experience in the area of nursing diagnostics. The minimum score a nurse expert should achieve is five points, including four points for Mater's education in nursing. The higher number of points is a sign of higher expertise (Fehring, 1994). Based on the experience, Fehring (1994) states it is better to have the lower number of experts with a higher level of expertise than a large sample of experts with a low level of expertise.

Given the existence of uncertainties, difficulties and limitations in this topic, experts in some countries have suggested their own criteria. A rating system for experts for the Czech Republic and the Slovak Republic was adapted by Zeleníková et al. (2010). The main criteria include the level of education and duration of professional clinical practice. The additional criteria include specialty/certification in the area of clinical practice to the relevant area of the diagnosis, a diploma/rigorous thesis on the area relevant to the nursing diagnosis, and a published paper on the issue of nursing diagnostics.

In the present, the issue of the validity of the currently set criteria for expert selection in our conditions, due to the development and changes in the field of education in nursing, is

constantly dominating. Adoption of inappropriate expert selection criteria affects results of validation studies and has a significant effect on validity of the findings.

Objective

The objective of the present study is to find out meeting the expert selection criteria for research on content and clinical validation of nursing diagnoses, outcomes, and interventions in the Slovak Republic, and evaluate their relevance and validity.

Sample, methodology

A cross-sectional study was used. A total of 435 nurses were rated with the use of the self-administered questionnaire that rated the recommended criteria for experts for validations in nursing according to Fehring (1994) and Zeleníková et al. (2010). The data was collected from October 2021 to May 2022.

The criteria according to Fehring (1994) included: Master's degree in nursing – four points; Master's degree in nursing with the diploma thesis on the study of nursing diagnostics – one point; A published paper on nursing diagnostics in a journal – two points; A published paper on nursing diagnostics with relevant content in the studied area – two points; PhD. in nursing diagnostics – two points; Clinical practice, at least one year in the relevant area – two points; and A certificate (specialty) in the relevant clinical practice in diagnostics – two points. An expert is a nurse who achieves the minimum of five points according to the set criteria, including four points for Master's education in nursing.

The criteria according to Zeleníková et al. (2010) included: the basic criteria – education in the field of Nursing (Master's/PhDr. education in nursing – three points; Bachelor education in nursing – two points; Secondary School of Nursing/Higher Vocational Study – one point) and clinical practice (Current clinical practice (at least one year) in the area of the relevant diagnosis – one point; Clinical practice more than five years – two points; Clinical practice more than ten years – three points); and the additional criteria – Specialty/certification (for example, a certified course, a course for mentors, etc.) in the area of clinical practice to the relevant area of the diagnosis – two points; A diploma/rigorous thesis on the area relevant to the nursing diagnosis – one point; A published (research or theoretical) paper on nursing diagnostics – two points; and A dissertation on nursing diagnostics – three points. A clinical expert is a nurse who achieves the minimum of four points according to the set criteria. The study was approved by the University Ethics Committee. The IBM SPSS 24.0 statistical programme, simple descriptive statistics were used for data analysis.

Results

In the first part, the results on meeting the criteria for experts in nursing according to the recommended criteria by Fehring (1994) are presented in Table 1.

Tab. 1 Meeting the criteria for experts in the Slovak Republic according to Fehring (1994)

	n	%
Master's degree in nursing	87	20.00
Master's degree in nursing with the diploma thesis on the study of nursing diagnostics	45	10.30
A published paper on nursing diagnostics in a journal	34	7.80
A published paper on nursing diagnostics with relevant content in the studied area	129	29.70
A certificate (specialty) in the relevant clinical practice in diagnostics	280	64.40
PhD. in nursing diagnostics	7	1.60
Clinical practice, at least one year in the relevant area	435	100

Obtaining a Master's degree in nursing as a criterion was met by n = 87 (20 %) addressed respondents – nurses. The criterion of clinical practice was met by all n = 435 (100 %) respondents. Out of the rest of the criteria, the criterion of obtaining a certification (specialty) in the relevant clinical practice in diagnostics dominated, n = 280 (64.40 %).

In Table 2, the met criteria for experts in nursing according to the adapted criteria for the Slovak Republic and the Czech Republic according to Zeleníková et al. (2010) are presented.

Tab. 2 Meeting the criteria for experts in the SR according to Zeleníková et al. (2010)

Basic criteria		
Education in the field	n	%
Secondary School of Nursing/Higher Vocational Study	263	60.50
Bachelor education in nursing	85	19.50
Master's/PhDr. education in nursing	87	20.00
Clinical practice		
Clinical practice (current clinical practice, at least one year in the area of the relevant diagnosis)	60	13.80
Clinical practice more than five years	36	8.30
Clinical practice more than ten years	339	77.90
Additional criteria		
Specialty/certification (for example, a certified course, a course for mentors, etc.) in the area of clinical practice to the relevant area of the diagnosis	280	64.40
A diploma/rigorous thesis on the area relevant to the nursing diagnosis	45	10.30
A published research or theoretical paper on nursing diagnostics	34	7.80
A dissertation on nursing diagnostics	7	1.60

The criterion of education was met to the greatest extent in the category of Secondary School of Nursing/Higher Vocational Study, n = 263 (60.50 %). Master's education was completed by n = 87 (20 %) addressed respondents. In the criterion of clinical practice, the highest frequency was in the category of clinical practice more than ten years, n = 339 (77.90 %). In the additional criteria, the highest frequency of answers was in the category of specialty/certification, n = 280 (64.40 %).

Discussion

In the present, there is inconsistency in the criteria for experts – nurses in nursing validation studies. In expert selection, some studies (Cavalcante et al., 2013; Chaves, Carvalho, Terra, et al., 2010) use the criteria according to Fehring (1994), while other researchers use various adaptations of the criteria (Seganfredo & Almeida, 2011; Teixeira et al., 2011; Zeleníková et al., 2014) (see Table 3).

Tab. 3 Comparison of experts in nursing by the number of points for meeting the criteria according to Fehring (1994) and Zeleníková et al. (2010)

	n	%
Fehring criteria (5p)	158	36.30
Fehring criteria (5p) + Master's	87	20.00
Zeleníková et al. criteria (4p)	394	90.60
Zeleníková et al. criteria (4p) + Master's	87	20.00

According to the findings of the present study conducted in the Slovak republic, we can state that obtaining a Master's degree in nursing as a set basic criterion was met by 20 % of the addressed respondents – nurses, and those nurses achieved the minimum of five points with another criterion; thus, the criteria for expert selection for nursing validation studies according to Fehring (1994) were met.

According to Quatrini Carvalho Passos Guimarães et al. (2016), the Fehring's criteria value academic experience over clinical experience. A group of experts that validates nursing diagnoses, interventions, or outcomes must consist of nurses (individuals) with various characteristics: recognised clinical leadership and/or recognised scientific ability in the relevant area of knowledge. The individuals must confirm such knowledge through degrees in a specialty, Master or PhD. or peer-reviewed publications (Quatrini Carvalho Passos Guimarães et al., 2016). Furthermore, to set the selection criteria, it is necessary to rate clinical practice of nurses (individuals) in accordance with the studied phenomenon, as well as experience with nursing classifications.

Several validation studies have rated clinical practice in expert selection (Lopes et al., 2010; Seganfredo & Almeida, 2011; Souza et al., 2014). Benner et al. (1992) state that the value of clinical practice is described as a precursor to achieve excellence in professional practice. Through the initiative of the nurses, the members of The Study, Research and Assistance Group on the Nursing Process (GEPASAE), clinical practice of at least four years in a specific area of the study is considered to be a compulsory criterion for a nurse to be considered an expert.

In the Slovak Republic and the Czech Republic, uniform national criteria have been set by Zeleníková et al. (2010). The criteria for expert selection in nursing validation studies are divided into main and additional. The main criteria include the level of education and duration of professional clinical practice; thus, the authors reflected to the already set requirements for the change of criteria. The highest number of points for expertise for education may be obtained by Master's education, while other options of education in nursing are possible. The criterion

of clinical practice is classified by its duration; the highest number is obtained by nurses for more than ten years, but they may obtain one point just for one year of clinical practice.

The findings of the present study show that the criterion of education in accordance with the recommended criteria by Zeleníková et al. (2010) was met in the highest frequency in the category of Secondary School of Nursing for which nurses get one point. In the criterion of clinical practice the highest frequency was in the category of clinical practice more than ten years, for which the nurses got three points. The sum of these criteria was enough to meet the set criteria for experts according to Zeleníková et al. (2010). The minimum of four points needed to become an expert in validation studies according to Zeleníková et al. (2010) would be achieved by more than 90 % of the nurses in the present study.

It is certainly important to reflect on the need for change and re-evaluate the recommended national criteria in our conditions, maintaining the importance of clinical experience to a greater extent than academic experience, but also respecting the maintenance of academic requirements such as a minimum Master's degree, or other additional criteria for demonstrating knowledge. In this category, we may include the activities suggested by Zeleníková et al. (2010): specialty/certification; diploma/rigorous thesis on the area relevant to the nursing diagnosis; a published paper on nursing diagnostics; and a dissertation on nursing diagnostics.

Conclusions

Based on the findings of the present study and given the changes and development in nursing as a science and education also in the Slovak Republic, we recommend updating the recommended criteria for expert selection for nursing validation studies, and thus meet the basic methodological requirement to achieve validity of findings of nursing validation studies in our conditions. It is suitable to maintain the importance of clinical practice, but it is also necessary to consider the level of knowledge, i.e. maintain the importance of criteria resulting from academic requirements. Nurse experts should not randomly switch between several specialties, because their greatest value is being an expert in their field.

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COVID-19 AND PIMS AS NEW CHALLENGES IN PEDIATRIC PATIENT CARE

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Abstract

The coronavirus pandemic, which lasted from March 20, 2020 to May 15, 2022, mainly affected adults. Initially, no infections were observed among children, but it was suspected that children often "transmit" infections to adults or infections among children are asymptomatic. Sore throat, weakness followed by nausea, diarrhea and smell and taste disorders have become symptoms that are increasingly common among children of all ages.

Pediatric multisystemic inflammatory syndrome, temporarily associated with SARS-CoV-2 infection (PIMS-TS) or pediatric multisystemic inflammatory syndrome (MIS-C) is an acute inflammatory syndrome that can develop cardiac complications (primarily: acute myocarditis with decreased left ventricular ejection fraction,) or shock. PIMS occurs after SARS CoV-2 infection (often asymptomatic or sparsely symptomatic) about 2-4 weeks earlier.

It is comforting to know that timely and effective treatment undertaken allows the vast majority of young patients to recover within days. Inpatient therapy should be carried out with the participation of a multispecialty consortium (infectious disease physicians, cardiologists, rheumatologists, hematologists, possibly a pediatric intensive care specialist). The goal of treatment is primarily to suppress inflammation. In some patients with a mild, self-limiting course of the disease, symptomatic treatment may be sufficient.

The fight against SARS CoV-2 virus, and consequently PIMS syndrome, requires further knowledge and learning about ways to prevent the disease and new methods of treatment for both adult and young patients so as to prevent complications and sequelae of the infection.

Keywords: children, SARS CoV-2, COVID-19, PIMS syndrome

Introduction

In December 2019, a new disease (SARS-CoV-2) caused by coronavirus (COVID-19) was detected in Wuhan, Hubei Province of the People's Republic of China (Wang et al. 2020) In the following weeks, infections spread in China and other countries around the world (Ghinai et al. 2020; Phan et al. 2020). By March 11, 2020, more than 125,000 cases and 4,500 deaths had been reported worldwide (https://www.worldometers.info). As a result, the World Health Organization has classified the COVID-19 outbreak as a pandemic.

In the early days of the COVID-19 outbreak, children were rarely ill, and pediatric cases were reported sporadically. It was thought that children were not susceptible to infection or that the lower incidence in this age group was due to fewer contacts and limited movement (Lee et al. 2020). The first confirmed pediatric case of SARS-CoV-2 infection was reported in Shenzhen on January 20, 2020. (Chan et al. 2020). However, with increased close contact with infected individuals in families, symptoms of COVID-19 have gradually been recognized in children. (Sybil 2020). It is now known that children are much more likely to contract COVID, and with the emergence of new variants of the virus, these cases will increase.

Already after the first wave of the 2019 coronavirus pandemic (COVID-19), there were cases of children presenting with atypical multisystemic inflammation (Schlapbach et al. 2021). The first reports of multisystem inflammatory syndrome in children arrived from Europe and North America in April 2020. The reported cases involved young patients with severe multisystem inflammatory syndrome associated with SARS-CoV-2.

COVID-19 in children

Children of all ages are at risk of being infected with SARS-CoV-2 and contracting COVID-19, but the number of infections and severity of illness vary by age. A higher number of infections and cases of severe disease predominate in older age groups (Kim et al. 2020). The clinical picture and severity of SARS-CoV-2 infection in children of all ages can vary from an asymptomatic course to a state of critical illness. At the onset of the disease, most children experienced respiratory symptoms or exacerbation of comorbidities. Children with COVID-19 who do not require hospitalization have more subclinical, asymptomatic infections and upper respiratory tract symptoms than adults (Yousaf et al. 2021; Li et al. 2020;8).

In the early stages of the pandemic, the most commonly reported symptoms in older (10-19 years) and younger (0-9 years) children from the United States were fever, cough and headache (older 46%, 37%, 15%, younger 35%, 41%, 42%, respectively) (Stokes et al. 2020). In published studies from the United Kingdom, with infected school-aged children (5-17 years),

the most commonly identified symptoms were headache 62%, fatigue 55%, sore throat 46%, fever 38%, and altered taste or smell 40%, which mainly affected children in the older age groups (12-17 years). In addition, it is worth mentioning that the presence of gastrointestinal symptoms such as abdominal pain, nausea, vomiting and diarrhea were common in the acute stage of COVID-19 in children (Molteni et al. 2021).

The National Institutes of Health (NIH) has developed COVID-19 severity categories to standardize treatment recommendations: asymptomatic, mild, moderate, severe and critical acute COVID-19 (https://www.covid19treatmentguidelines.nih.gov). Note that these definitions are extrapolated to pediatric infections; normal vital signs and symptoms will vary by age. The diagnosis of asymptomatic infection in younger children will depend on the clinical history provided by the caregiver and physical examination findings. Children with minimal symptoms will require careful assessment of vital signs and physical examination to ensure appropriate treatment (Gandhi et al. 2020). In children with severe disease, careful consideration should be given to distinguishing cases of acute COVID-19, with other diseases, as evaluation and management may differ. In a cross-sectional study of children with acute COVID-19, the risk of hospitalization or severe COVID-19 was highest in children with obesity, sleep disorders, diabetes (type 1 or type 2), congenital heart disease, neurodevelopmental disorders, mental illness, and hypertension. Among adolescents (12 - 18 years), those with asthma were at increased risk for severe disease (Kompaniyets et al. 2021). Other possible conditions causing severe disease include genetic disorders (Newma et al. 2021), sickle cell anemia (Arle et al. 2020), congenital heart disease (Sanna et al. 2020) and immunosuppression (DeBiasi 2020; Kosmeri et al. 2020).

SARS-CoV-2 infection often causes respiratory tract infection with extrapulmonary symptoms documented in case reports or case series in children. A number of neurological complications associated with acute COVID-19 in children have been described, including encephalopathy, seizures, encephalitis, Guillain-Barre syndrome, acute demyelinating syndromes, movement disorders and psychiatric disorders (Ray et al. 2021). The course of acute COVID-19 syndrome in children can also be complicated by cardiovascular events, including myocarditis (Trogen et al. 2020; Lara et al. 2020) pericarditis (Raymond et al. 2020; Dimopoulou et al. 2021), pulmonary embolism (Panjabi et al. 2021), arrhythmia (Samuel et al. 2020), acute myocardial infarction (Persson et al. 2021), and skin complications (so-called "covidien fingers" or frostbite-like (Andina et al. 2021; Andina, et al. 2021). Acute pancreatitis (Paz, et al. 2021) and hepatitis (Brisca, et al. 2021; Perez, et al. 2020) and renal dysfunction (Stewart, et al. 2020) have also been described in the subject literature as complications of COVID-19.

Polysystemic inflammatory syndrome (PIMS) in children

The disease is most commonly referred to as pediatric multisystemic inflammatory syndrome temporally associated with SARS-CoV-2 infection (PIMS-TS) or pediatric multisystemic inflammatory syndrome (MIS-C) (Hoste et al. 2021). Despite many studies attempting to elucidate the underlying biological and genetic mechanisms of PIMS-TS, its pathophysiology and observed variability in clinical presentation remain largely unknown (Carter et al. 2021). Paediatric inflammatory multisystem syndrome associated with coronavirus disease (COVID-19 - PIMS) results from immune dysregulation resulting from a history of SARS CoV-2 infection (often asymptomatic or sparsely symptomatic) approximately 2-4 weeks earlier (Whittaker et al. 2020). PIMS is an acute and potentially dangerous inflammatory syndrome that can develop cardiac complications (primarily: acute myocarditis with decreased left ventricular ejection fraction,) or shock. In contrast, coronary artery aneurysms are indicated among the most common permanent complications. Effective treatment undertaken in a timely manner allows the vast majority of young patients to recover within days. (Okarska-Napierała et al. 2020). Based on U.S. data, it can be concluded that PIMS develops in about 1/1000 children infected with SARS-CoV-2. In the U.S. population, where most cases have been reported so far, the mortality rate is 1.5-2%, despite the treatment undertaken (Godfred-Cato 2020). PIMS is characterized by a heterogeneous clinical spectrum, with most patients presenting with cardiovascular, gastrointestinal and/or nervous system symptoms. A significant proportion of cases do not show respiratory symptoms, which is usually seen in adults (Hoste et al. 2021). The diagnosis of PIMS syndrome is based on 6 criteria, where at least criteria 1-5 should be met, only criterion 6 is not mandatory. Symptoms of PIMS usually appear gradually, and in the first few days, gastrointestinal complaints usually predominate, suggesting appendicitis. The diagnosis of the syndrome is also indicated by abnormalities in laboratory tests: very high inflammatory markers (the cutoff threshold for individual parameters has not been defined, but usually CRP is well above 100 mg/dL), lymphopenia, slight anemia (Godfred-Cato et al. 2020; Whittaker et al. 2020). Criteria for the diagnosis of COVID-19-associated multisystem inflammatory syndrome are presented in Table 1.

Tab. 1 Diagnostic criteria of paediatric inflammatory multisystem syndrome associated with COVID-19

Criterion	**Characteristics**
Age: Children (0-18 years)	School-aged children are the most commonly affected, with the median age being about 9 years old.
Fever Mandatory criterion	No defined threshold, but usually body temperature is > 38.5°C; lasting at least 3 days.
High inflammatory markers	Elevated values are: CRP, procalcitonin, ESR, fibrinogen, LDH, D-dimers, ferritin. There are no defined threshold values, but usually the values are well above normal.
Multi-organ damage (symptoms from at least two organs or systems)	Gastrointestinal tract: severe abdominal pain, vomiting, diarrhea, Cardiovascular system: hypotension, shock, features of myocarditis (by echocardiography or laboratory tests), coronary artery aneurysms, pericardial fluid, cardiac arrhythmias. Nervous system: apathy, irritability, features of aseptic meningitis, paresis or paralysis of peripheral nerves, severe headache. Respiratory system: cough, shortness of breath, features of pneumonia, pleural fluid, chest pain. Skin and mucosal symptoms: rash (polymorphous), conjunctivitis or conjunctival injection, "strawberry tongue," dry, red lips, swelling of the hands and feet. Renal symptoms: features of acute kidney injury, anuria, features of coagulopathy.
Exclusion of other causes	The following should be considered in the differential diagnosis: infectious and toxic causes, including sepsis, toxic shock syndrome, acute viral disease, acute appendicitis and peritonitis, systemic connective tissue diseases, proliferative diseases, inflammatory bowel disease.
Affiliation with COVID-19 present at least one of the following (current or past)	Positive RT-PCR result for SARS-CoV-2, Positive antigen test result for SARS-CoV-2, Positive antibodies for SARS-CoV-2. Documented significant exposure to COVID-19 in the past 4-8 weeks.

Due to the complexity of PIMS syndrome, in-hospital therapy should take place with the participation of a multispecialty consilium (infectious disease physicians, cardiologists, rheumatologists, hematologists, and possibly a pediatric intensive care specialist) (Harwood, et al. 2020). Treatment is aimed at achieving hemodynamic stabilization of the patient, including fluid therapy, according to generally accepted principles. Monitoring of vital signs is also important (Okarska-Napierała, et al. 2020). In terms of pharmacotherapy, antibiotic therapy is used, especially when in the initial phase of the disease the clinical picture of PIMS may resemble an invasive infection, including sepsis, toxic shock syndrome or other bacterial diseases (e.g., scarlet fever). Therefore, empirical antibiotic therapy is usually indicated, pending negative microbiological results. It should be taken into account that in strongly suspected PIMS, where there are high inflammatory markers indicative of immune dysregulation rather than bacterial infection, antibiotic therapy is ineffective and discontinuation is indicated (Harwood et al. 2020). Another group of drugs are antiviral preparations. Since the majority of patients with PIMS do not find SARS CoV-2 virus RNA in respiratory tract material, this treatment is not recommended. Only in a very small number of PIMS patients with a positive PCR result for SARS CoV-2 and SatO2 $\leq$ 94% may antiviral treatment be warranted (Harwood et al. 2020). An essential and primary role in the management of patients with PIMS is played by immunosuppressive and immunomodulatory treatment, introduced gradually, depending on the effects of the therapy used so far. The goal is primarily to suppress inflammation. In some patients with a mild, self-limiting course of the disease, symptomatic treatment may be sufficient (Harwood et al., 2020; Henderson et al. 2020). The first-line treatment is intravenous immunoglobulin infusion (IVIG). (Okarska-Napierała et al. 2020). Second-line drugs are corticosteroids (GCS). Treatment with steroids is indicated when the child's condition is severe or worsening, there are features of shock, no improvement, especially persistence of fever, 24 hours after the end of IVIG infusion. Third-line treatment is biologic drugs (Harwood et al. 2020; Henderson et al. 2020). In addition, anticoagulant treatment is introduced, as most patients with PIMS have features of coagulation disorders in laboratory results. Additionally, antiplatelet or anticoagulant therapy is indicated due to hemodynamic abnormalities and the possibility of developing coronary artery aneurysms (Okarska-Napierała et al. 2020; Schlapbach et al. 2021).

Conclusion

Knowledge of SARS-CoV - 2 virus, Covid-19 disease and PIMS multisystem inflammatory syndrome is constantly improving, and recommendations for therapy are changing.
Medical personnel caring for young patients are required to continually update their knowledge and act in accordance with binding standards based on high-quality evidence.

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URINARY TRACT INFECTIONS AMONG HOSPITALIZED PATIENTS WITH A URINARY CATHETER

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Abstract

Urinary tract infections (UTIs) are one of the most common infections encountered by both outpatients and inpatients. Catheterization and the length of time the catheter is maintained in the patient significantly increase the risk of infection. Treatment of patients with UTI is a very big problem not only therapeutically but also financially for hospitals. The purpose of this study was to determine whether the number of urinary tract infections among catheterized patients increased during the Sars-Cov-2 virus pandemic. In addition, whether the pandemic period contributed to an increase in the frequency of catheterizing patients. The study was conducted using information on the number of urine culture tests ordered and the number of positive results among patients with suspected UTI. Patients were qualified for the test on the basis of their clinical symptoms, and the test was carried out by inoculating the urine on Blood Agar with 5% sheep blood dehydrate and MacConkey medium. The result was presented as the number of grown microbial cells in 1 ml of urine. The results showed that during the COVID-19 pandemic, the number of patients with a urinary catheter increased but the number of nosocomial urinary infections decreased. Continuously increasing the awareness and knowledge of medical personnel about catheterizing patients and taking care to maintain a sanitary regime results in a decrease in the incidence of hospital-acquired urinary tract infections among catheterized patients.

Keywords: urinary trac infection, urinary catheter, nosocomical infection

Introduction

A nosocomial infection is any infection that occurred during a patient's hospitalization but did not remain incubating during the patient's admission to the hospital [Wójkowska-Mach et al., 2010; World Health Organization, 2011]. Detection of nosocomial infections is an important part of monitoring the epidemiological situation in the hospital and allows for their effective control. Among the methods of hospital infection control, we can enumerate: monitoring of procedures that promote the occurrence of infections among patients and medical staff, detection and early information about the occurring mechanisms of microbial resistance that occur, and surveillance of the antimicrobial drugs use. Factors that favor the occurrence of such infections can include urinary and intravenous catheters, mechanical ventilation and previously used antibiotic therapy [Dziewa and Ksyniewicz-Dorota, 2012; Trześniewska-Ofiara et al., 2022]. One of the most common nosocomial infections observed in both surgical and conservative wards is urinary tract infection. Currently, nearly 15% of all prescribed antimicrobial drugs are used to treat urinary tract infections These infections account for 40-50% of all nosocomial infections, and among Primary Care patients, the incidence of urinary tract infections is 10-20% [Bermingham and Ashe, 2012; Stamm and Norrby, 2001; Fihn, 2003; Dziewa and Ksyniewicz-Dorota, 2012]. Most often, the occurrence of urinary tract infections is influenced by retrograde urinary outflow and urinary stasis. In addition, anatomical defects, diabetes mellitus, bladder dysfunction, urological and diagnostic bladder procedures, as well as sexual activity and catheterization [Dzierżanowska et al., 2018; Matusiak, 2014].

Approximately 25% of patients have a urinary catheter in place during their hospital stay, and catheter-related urinary tract infections (UTIs) account for 80% of hospital-acquired urinary tract infections. It is well known that each additional day with a catheter in the bladder increases the risk of infection by 5% [Babska, 2020; Clarke et al., 2020]. Because of this high rate of urinary tract infections among patients with a catheter, all nursing procedures to reduce the possibility of developing an infection are very important. First and foremost, catheterization of patients is performed in those patients who show significant indications (e.g., a patient requiring long-term immobilization, a patient with incontinence or wounds in the perineal or anal area, the need to monitor diuresis in an uncooperative patient) [Bulanda and Wójkowska-Mach, 2016; Korman and Grayson, 1995]. Procedures performed during the insertion of a catheter into the urinary bladder should follow all principles of aseptics and antisepsis, since the hands of staff are largely responsible for the transmission of microorganisms that cause hospital-acquired infections. The bacterial flora acquired after contact with the hospital environment is responsible for most infections acquired during hospitalization [Garus-Pakowska and Szatko,

2009]. The irrational use of antibiotics and chemotherapeutics over the years to treat infections of hospitalized patients has resulted in the selection of strains resistant to many antimicrobial drugs, which are now largely responsible for nosocomial infections [Dzierżanowska et al., 2004; Szmulik et al., 2022].

Aim

The aim of this study was to analyze the incidence of urinary tract infections in 2019-2021 among patients with a urinary catheter hospitalized at Mazovian Specialized Hospital Ltd. (MSH) in Radom (Poland). The duration of the study was chosen to include the period before and during the pandemic caused by the SARS-CoV-2 virus. In addition, the aim of the study was to assess whether the number of urinary tract infections among hospitalized patients with a urinary catheter was higher during the COVID-19 pandemic period in relation to the period before the pandemic.

Materials and methodology

The material for the preparation of this study consisted of data obtained from patients hospitalized in the analyzed period. The criteria for the diagnosis of urinary tract infections were the clinical symptoms of the patients, which often vary widely from asymptomatic UTI to urosepsis. The clinical diagnosis was up to the attending physician of the hospitalized patient. In the examined patients we could observe, for example, dysuria, nycturia, frequent urination, pus. On the other hand, microbiological criteria for UTI were significant bacteriuria ($\geq 10^3$ CFU/ml). Catheterized urine was always collected through a freshly inserted, sterile catheter with all hospital procedures in place. The material delivered to the Microbiology Laboratory was inoculated using the Hoeprich method on Blood Agar with 5% dehydrated sheep's blood and MacConkey medium from Becton Dickinson using 0.01 ml and 0.001 ml disposable plastic inoculation loop (10^2 and 10^3 dilutions). The culture was carried out under aerobic conditions at 35-37 °C for 24 -48 h. The result was presented as the number of grown cells of the microorganism in 1 ml of urine. The pathogenic microorganisms were then subjected to identification and drug susceptibility determination using a Phoenix M50.

Results

Data from 21 hospital wards were used to compile this analysis. Catheter urine cultures were not obtained for only two departments, i.e. the Hospital Emergency Department and the Department of Pediatric Surgery. A total of 8863 urine culture tests were performed from the above-mentioned hospital departments, of which 2898 urine cultures were collected from patients with a urinary catheter. This accounted for 32.70% of all urine culture tests performed during the 3 years analyzed. In 2019, 30.40% of urine cultures were collected from patients with a urinary catheter, in 2020 it was 37.10%, while in 2021 it was 30.70% (Figure 1).

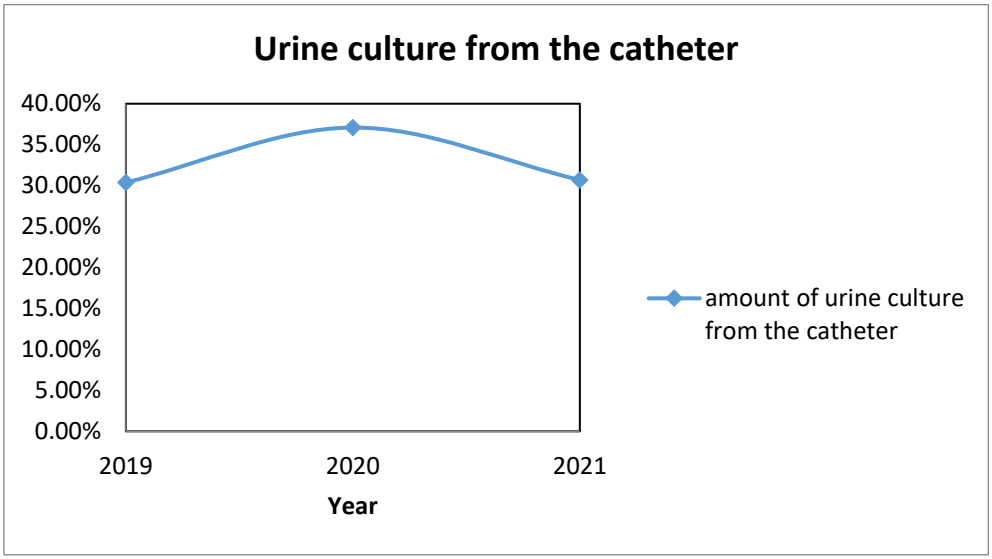

Fig. 1 Number of catheter urine cultures in 2019-2021

The data (Figure 1) shows that in 2020 there was an apparent increase (by 6.70%) in the testing of urine cultures collected from patients with a urinary catheter. This was probably related to the increase in the number of hospitalized patients with a bladder catheterization method (Table 1).

Tab. 1 Number of patients with urine culture test

	2019	2020	2021
Number of patients with positive catheter urine cultures	159	257	211
Number of patients with catheter-based urine culture test performed	412	583	524
Total number of patients with positive urine cultures	765	833	799
Total number of patients with urine culture test performed	1826	1885	2032
Number of patients with positive catheter urine cultures after 72 hr	111	152	127
Number of patients with catheter urine culture test after 72 hrs	232	310	287

The number of patients who had a urine culture from a urinary catheter in 2020 increased by as much as 41.50% compared to 2019, while in 2021 it increased by 27.18%. Assessing the analysis of the number of patients with positive urine culture from the catheter, it was found that in the first year of the pandemic their number increased by 98 (61.64%), and in the following year by 52 patients (32.70%). On this basis, it was noted that the first year of the pandemic caused by the Sars-CoV-2 virus, there was an increase in the number of hospitalized urinary catheter patients and the number of positive results. Table 2 shows detailed data on the number of catheter urine cultures ordered and positive results by the hospital departments analyzed. It was observed that the number of catheter urine cultures in the first year of the COVID-19 pandemic (2020) increased by 19.01%, and the number of positive results increased by 13.31% compared to 2019. In the second year of the pandemic (2021), the number of catheter urine cultures was similar to 2019, and the number of positive results decreased by 6.82%.

Tab. 2 Number of catheter urine cultures ordered and number of positive tests

	2019		2020		2021	
Hospital Deprtment	Number of materials	Positive tests	Number of materials	Positive tests	Number of materials	Positive tests
Clinical Department of General, Oncological, Metabolic Surgery	16	11	5	3	8	3
Clinical Department of Neurology Stroke Subdivision	12	8	17	8	22	8
Clinical Department of Oncology	4	1	14	6	7	2
Clinical Department of Otolaryngology and Laryngological Oncology	0	0	2	0	1	0
Clinical Department of Pediatrics	5	3	2	0	1	1
Clinical Department of Rehabilitation	2	0	2	1	2	2
Clinical Internal Department I	44	21	34	13	14	6
Department of Trauma and Orthopedic Surgery	1	0	0	0	1	1
Clinical Department of Gynecology and Obstetrics	4	0	0	0	0	0
Hematology Department	12	6	10	4	6	2
Department of Cardiac Surgery	6	0	8	2	7	1
Clinical Department of Cardiology	0	0	0	0	1	0
Neonatology Department	4	2	2	0	3	0
Department of Pulmonology and Pulmonary Oncology	2	0	2	0	0	0
Department of Neurological Rehabilitation	5	4	7	5	8	6
Rheumatology subdivision	1	1	1	1	1	1
Internal Department II	56	25	144	74	225	97
Department of Anesthesiology and Intensive Care	709	210	810	220	565	139
Hospital Clinical Department of Neurosurgery	27	16	23	12	33	18
Total	910	308	1083	349	905	287

Comparing the data in Table2 to the number of patients (Table 1), it was observed that in 2020 there was an increase in both the number of patients with a catheter urine culture test performed and the number of positive patients but also in the number of specimens collected and positive results obtained from them. In 2021, the number of patients with a catheter urine culture test performed and the number of patients with positive catheter urine cultures test continued to be higher than before the pandemic caused by the Sars-CoV-2 virus began, but the number of materials collected from patients and positive results obtained from them decreased (Figure 2).

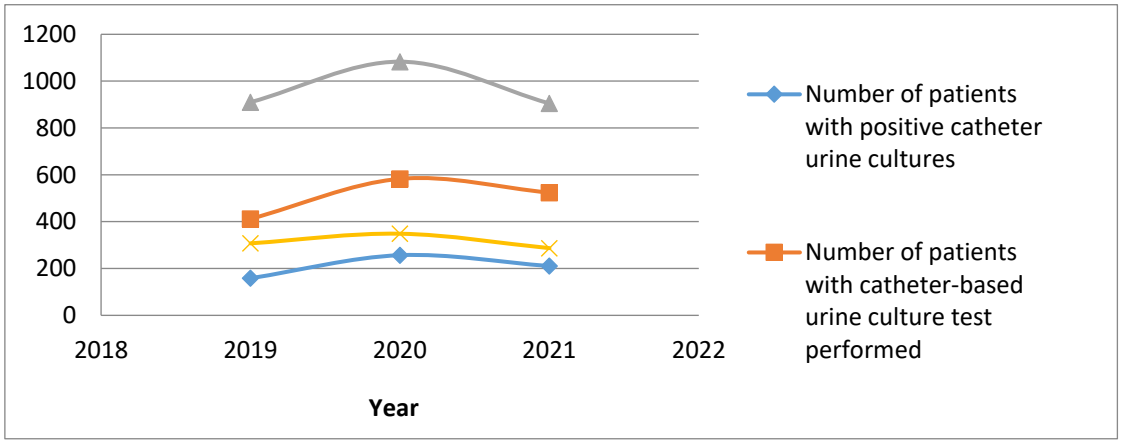

Fig. 2 Summary of the number of patients and materials collected

Catheter urine collected 72 h after the patient's admission to the hospital accounted for 19.93% of all urine cultures performed in the years analyzed. In contrast, positive results were obtained in nearly 70% of all catheter urine cultures (Table 3).

Tab. 3 Number of catheter urine cultures performed after 72 h and positive results

	2019		2020		2021	
Hospital Deprtment	Number of materials	Positive tests	Number of materials	Positive tests	Number of materials	Positive tests
Clinical Department of General, Oncological, Metabolic Surgery	15	11	5	3	7	2
Clinical Department of Neurology Stroke Subdivision	8	6	11	6	11	4
Clinical Department of Oncology	1	1	6	4	4	2
Clinical Department of Otolaryngology and Laryngological Oncology	0	0	1	0	1	0
Clinical Department of Pediatrics	2	1	2	0	0	0
Clinical Department of Rehabilitation	2	0	2	1	1	1
Clinical Internal Department I	17	12	4	3	1	1
Department of Trauma and Orthopedic Surgery	1	0	0	0	1	1
Clinical Department of Gynecology and Obstetrics	1	0	0	0	0	0
Hematology Department	9	4	9	4	4	0
Department of Cardiac Surgery	2	0	6	2	6	1
Clinical Department of Cardiology	0	0	0	0	1	0
Neonatology Department	1	0	1	0	1	0
Department of Pulmonology and Pulmonary Oncology	2	0	1	0		
Department of Neurological Rehabilitation	5	4	7	5	6	5
Rheumatology subdivision	0	0	0	0	1	1
Internal Department II	21	9	47	22	79	39
Department of Anesthesiology and Intensive Care	490	180	491	159	394	114
Hospital Clinical Department of Neurosurgery	26	16	21	11	31	18
Total	603	244	614	220	549	189

Urine cultures collected from the catheter after 72 h in 2019 were 66.26%, in 2020 - 56.69%, in 2021 - 60.66% in relation to all urine collected by this method. If we consider the number of patients with a urinary catheter (Table 1) who had a positive urine culture 72 h after admission to the hospital, hospital-acquired urinary tract infection among patients catheterized in the analyzed years was found in 26.94%, 26.07% and 24.24% of patients, respectively. Positive urine culture results from a catheter collected after 72 hours accounted for 79.22% in 2019, 63.03% in 2020 and 65.85% in 2021. It was found that the number of nosocomial infections among catheterized patients was the highest before the COVID-19 pandemic. In the first year of the pandemic, the number of infections decreased by 16.19%, while in the second year, the number of cases decreased by 13.37% compared to 2019. Although in 2020 both the number of patients with positive catheter urine cultures and the number of positive materials increased compared to 2019, the number of nosocomial urinary tract infections among catheterized patients decreased slightly (by 0.87%), and in 2021 there was another decrease in the number of patients with nosocomial UTI by 1.83% (Figure 3).

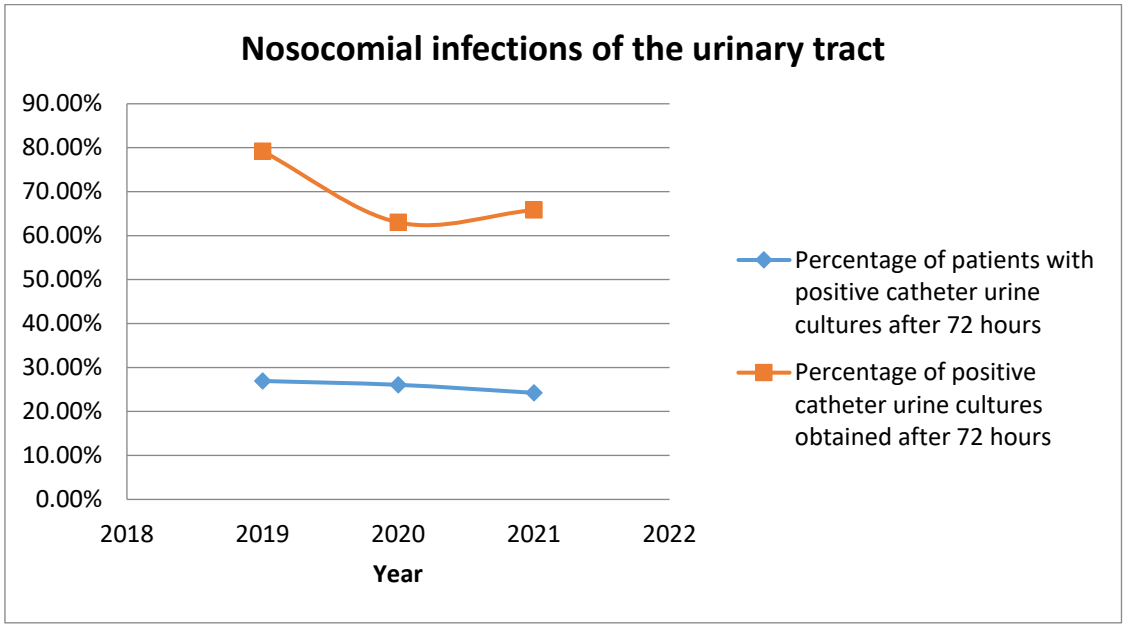

Fig. 3 Number of nosocomial infections among patients and analyzed material.

Discussion

Nowadays, hospital-acquired infections are a very important topic addressed by both medical and non-medical communities. Performing infection control requires comprehensive knowledge of microbiology, epidemiology or finance. It is believed that one of the most important criteria for the quality of medical service provision is hospital infection control. This has an impact on reducing morbidity, mortality and medical costs [Dziewa and Ksyniewicz-

Dorota, 2012]. Urinary catheter-related infections cause thousands of deaths per year and consume millions of dollars in patient treatment, yet these infections could be avoided [Whitaker et al., 2022]. Not only physicians but also the nursing team have a huge impact on the incidence of hospital-acquired infections. The level of knowledge, continuous education are important aspects that affects the health and lives of patients and the work of medical staff. Unfortunately, more than half of nurses are unaware that the bacterial flora that temporarily colonizes the hands of staff (including fingernails) is responsible for most infections associated with hospitalization and the occurrence of outbreaks [Garus-Pakowska and Szatko, 2009; Szarek et al., 2021]. Education of medical personnel and the daily practice of assessing the indications for catheterizing patients contribute significantly to reducing catheter use and the incidence of urinary tract infections among catheterized patients [Menegueti et al., 2019].

A study in the United States showed that during the pandemic caused by the Sars-CoV-2 virus, there was no increase in urinary tract infections in patients with a urinary catheter, results remained at previous levels [Fakih et al., 2022]. By implementing increased caution and sanitation regimens during the COVID-19 pandemic and analyzing the need for urinary catheter insertion at University Hospitals Parma Medical Center (UHPMC) in Parma, Ohio, the rate of urinary tract infections in urinary catheter-related infections decreased [Whitaker et al., 2022]. In MSH, it was also observed that the number of hospital-acquired infections decreased during the pandemic. However, the overall prolonged stay in the ICU promoted the occurrence of urinary tract infections [Zhang et al., 2020].

Urinary tract infections can be caused by, among others, uropathogenic *Escherichia coli* responsible for about 40% of hospital urinary tract infections and 80-90% of out-of-hospital infections [Walters et al., 2012; Bachller and Berenstein, 1997; Parker et al., 2009]. Besides, UTIs can be caused by *Enterococus faecalis, Staphylococcus saprophiticus*, and in the hospital environment also *Acientobacter baumannii, Pseudomonas aeruginosa*. Similar microorganisms are isolated from patients with a urinary catheter, although prolonged catheterization affects the more frequent isolation of Gram-negative bacilli, such as *Proteus, Serratia, Pseudomonas* [Przybyła and Sosnowski, 2008].

Urinary tract infections are determined by the ability of bacteria to adhere to the epithelium lining the urinary tract and the ease of bacterial biofilm formation on the catheter surface [Chmielewska and Leszczyńska, 2020; Ostrowska et al., 2013]. It is believed that more than 60% of urinary tract infections are associated with the phenomenon of biofilm formation. All patients with a catheterization period of more than 28 days are found to have urinary tract infections. The secretion that accumulates in the urethra around the catheter causes

microorganisms to enter the bladder, and this can eventually lead to dangerous complications such as pyelonephritis or even septicemia [Ostrowska et al., 2013, Trześniewska-Ofiara et al., 2022]. Urinary tract infections can be either asymptomatic or acute, symptomatic infections of varying location and course [Chmielewska et al., 2016]. Most commonly, urinary tract infections are caused by microorganisms colonizing the gastrointestinal tract and the patient's perineal area, as well as by bacteria found on the hands of medical personnel and on the contaminated ends of the urine bag [Babska, 2020; Chmielewska et al., 2016]. The symptoms most commonly associated with urinary tract infections are fever, dysuric symptoms, bladder tenderness, unpleasant urine odor, and low back pain [Matusiak, 2014; Bury, 2008].

Urinary catheter-related infections are increasingly caused by drug-resistant microorganisms, so reducing catheterization time remains a very important aspect of reducing these infections. Asymptomatic bacteriuria of urethral catheter patients should not be treated, and routine follow-up urine collections have no diagnostic justification [Chuang and Tambyah, 2021]. Sterility of the urinary catheter system is a very important element in the prevention of UTI. Continued research focuses the use of modified catheters and aseptic insertion and maintenance of the catheter in the urinary tract [Chuang and Tambyah, 2021].

In conclusion, by implementing a multidirectional system for the prevention of urinary tract infections associated with the urinary catheter, it is possible to successfully reduce their incidence in health care facilities [Whitaker et al., 2022].

Conclusions

The results showed that during the COVOD-19 pandemic, the number of urinary catheter patients with a positive urine culture test increased compared to 2019. However, comparing the number of patients with a positive urine culture taken after 72 hours from patients with a urinary catheter to the total number of patients with a urinary catheter who had a urine culture, it was found that the number of nosocomial infections involving the urinary tract of patients with a urinary catheter decreased during the COVID-19 pandemic compared to 2019.

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BIOFILM FORMATION BY STAPHYLOCOCCUS AUREUS IN DEPENDENCE ON ENVIRONMENTAL CONDITIONS

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Abstract

The influence of water activity (in range of aw 1.0-0.86), pH (6.5-4.0) and their combinations (pH 6.0; 5.5 and 5.0 and aw 0.99 and 0.97) on the biofilm formation by two S. aureus isolates on two different contact materials – plastic material and stainless steel was described. It was found that there weren't statistically significant differences ($p < 0.05$) in ability of two isolates to form biofilm on two different stainless-steel plates, type M and L. Based on results it can be stated that the biofilm formation by both isolates was promoted with salt addition to 5% and with further decrease of aw S. aureus ability to produce biofilm decreased. However, the biofilm formation was noticed also at aw 0.855, on both materials. Further, the biofilm formation by two isolates started gradually to decrease with decreasing of pH value. The lowest pH value at which S. aureus was able to produce biofilm was pH 4.0. The effect of combination of factors on biofilm formation on plastic material was inhibited compared to their individual effect. The amount of biofilm produced on stainless steel surface has been reduced, insufficiently, by the addition of salt and reducing of the pH value to 5.0. It can be concluded that the combination of aw and pH did not reliably eliminate the formation of biofilm but by using aggressive combination of factors, better results can be obtained. The most effective way to inhibit biofilm formation on both materials was at pH 4.0.

Keywords: S. aureus, biofilm, environmental factors

Introduction

Biofilm formation provides to the microorganisms a lot of advantages. Biofilm seems to be the best strategy for bacteria to survive any kind of environmental stress (Reffuveille et al., 2017). Cells growing in multispecies community can protect themselves against different inhibitive, disinfectant, and antimicrobial compounds, moreover, they can better survive the lack of nutrients. Biofilm is defined as a multicellular, organized structure built by almost all bacterial species. In any case, the life of biofilm starts by an adhesion of cells on a surface (plastic, steel, glass, e.i.). Availability of key nutrients, chemotaxis towards surface, motility of bacteria, surface adhesins and presence of surfactants are some factors which influence biofilm formation (Hussein et al., 2011). After cell proliferation, a monolayer is formed and subsequently with maturation of the biofilm in favourable conditions the cells from biofilm are released and spread into the media. The structure of biofilm is dynamically changed in dependence on actual environmental factors (Branda et al., 2005). One of the bacteria that are very often involved in biofilm formation is also S. aureus. Its presence on medical devices or on/in patients is concerning due to the presence of its pathogenic and enterotoxinogenic strains. As a pathogen, S. aureus, disposes of remarkable wide range of pathogenic factors causing different infectious and food-borne outbreaks. Therefore, the aim of our work was to describe the effect of temperature (30 and 37 °C), pH (6.0, 5.5, 5.0, 4.5 and 4.0 adjusted by lactic acid), water activity (from 1.0 to 0.86 adjusted by NaCl addition) and their combinations on the biofilm formation by enterotoxinogenic S. aureus 14733 and non-enterotoxinogenic S. aureus 2064 on the plastic and stainless-steel surfaces.

Material and methods

The S. aureus ability to from biofilm was described by using two different isolates, enterotoxinogenic 14733 and non-enterotoxinogenic 2064. Isolate S. aureus 14733 originated from the milk vending machine surface and was isolated and identified at the Public Health Authority Institute (Dolný Kubín, Slovakia), isolate S. aureus 2064 originated from ewes' lump cheese and was isolated by Dr. Hanzélyová at the State Veterinary and Food Institute (Prešov, Slovakia). They were maintained on slopes of PCA (Plate Count Agar; Merck, Darmstadt, Germany) at 5 °C. From them, the standard 18 h old culture of S. aureus was inoculated into the pre-tempered nutrition broth (containing glucose, tryptone, and yeast extract; Merck, Darmstadt, Germany) with adjusted values of pH, aw and their combination and cultivated at 30 and 37 °C. The pH value was adjusted by 5% lactic acid prior to the sterilisation of the media, the aw value was adjusted by the NaCl addition to the final value of 1.00; 0.99; 0.97;

0.95; 0.93; 0.91; 0.89; 0.86 a 0.84. Combination of the factors was studied at aw 0.99 and 0.97 and pH 6.0, 5.5. and 5.0.

The formation of biofilm on stainless-steel plates was studied by cultivation of S. aureus at selected conditions for 24 hours at 30 or 37 °C in Petri dishes where the plates, M or L, were put. After that the counts of S. aureus in the media was determined by cultivation dilution method on Baird-Parker agar according to EN ISO 6888-1. Also, the counts of S. aureus in media without stainless steel plates were determined as a control. So, the counts of S. aureus forming the biofilm were determined as counts of S. aureus in control minus counts of S. aureus in media with plates.

The formation of biofilm on plastic materials were studied using method described by Beenken et al. (2003). After cultivation, the biofilm production was expressed by determination of absorbance at 630 nm. As a positive control Pseudomonas aeruginosa was used and as a negative control S. aureus CCM 3988. Statistical analyses carried out using Student' s t-test.

Results and discussions

Biofilm formation affected by water activity value

Figure 1 shows the results of the influence of aw in the range of 0.84 to 1.0 on the formation of biofilms on stain-less steel plates and on plastic material, obtained by the cultivation method on both types of plates for selected S. aureus isolates. From Figure 1 the gradual reduction of aw from 0.99 to 0.84 resulted primarily in growth inhibition for both isolates on steel. However, it is noteworthy that when aw was reduced from 0.996 (medium without salt addition) to aw value of 0.979 (1.72% salt addition), a slight increase in the number of cells growing in the biofilm was observed, and it was about 1.9% for 14733 isolate and about 10.5% for 2064 isolate. In this context, it can therefore be assumed that the addition of salt not only stimulates the growth of S. aureus, but also its ability to adhere to the steel surface and form microbial communities on it. The aw value of nutrient media for both monitored isolates gradually decreased from aw 0.974 (5% NaCl) to aw 0.853 (19% NaCl). As a result, a decreasing trend in the number of CFU/ml was achieved, which implies that with a decreasing value of aw, not only the ability of S. aureus to grow in each environment decreases, but also the ability of isolates to form a biofilm decreases proportionally.

In case of S. aureus ability to produce biofilm on plastic, isolate S. aureus 14733 formed the largest amount of biofilm on plastic at aw 0.991 (1.72% NaCl) and, conversely, the lowest

biofilm formation was surprisingly observed at aw 0.973 (5% NaCl). In the medium without the presence of salt (aw 0.998), the ability of isolate 14733 to form a biofilm was lower than at 1.72% addition of salt to the broth. Thus, with a decrease in the aw value, cell grouping increased by up to 54.6% to the community. Subsequently, with the addition of 5.0% salt, which resulted in a reduction of av to the level of 0.973, a 3.6-fold reduction in the ability of isolate 14733 to form a biofilm can be observed on a plastic surface. Moreover, its ability to form biofilm was comparable with the ability of P. aeruginosa (PA).

In the case of the second isolate S. aureus 2064, the biofilm production ability was lower compared to S. aureus 14733. The highest production was recorded at aw of 0.998 (without NaCl addition) and the weakest production was recorded at aw of 0.894 (15.25% NaCl). In contrast with from the amount of biofilm formed by the enterotoxinogenic isolate, the amount of biofilm formed by the second isolate gradually decreased with decreasing aw value.

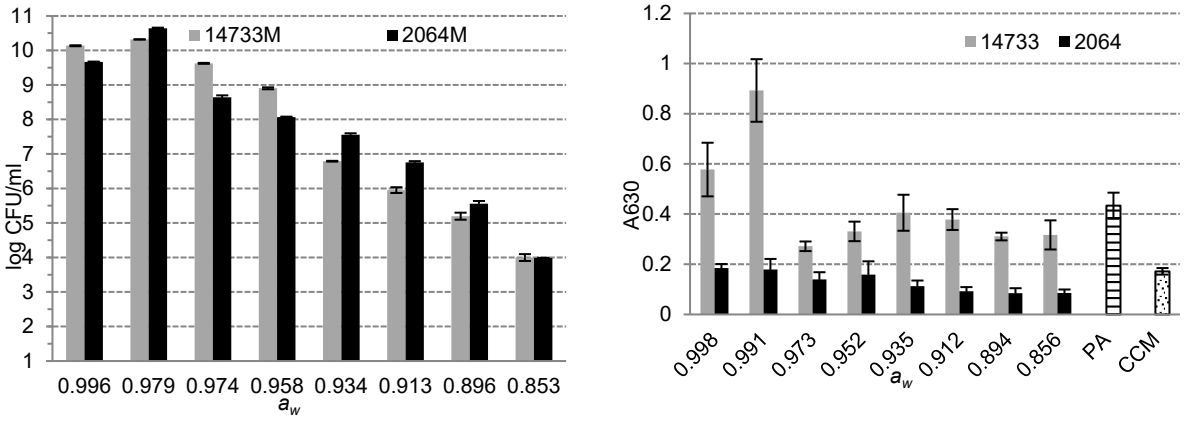

Fig. 1 Effect of water activity on the biofilm formation by *S. aureus* on stainless steel plates and on plastic material at 37 °C

Biofilm formation affected by pH value

The effect of pH on the production of biofilms was observed in the range of pH values 6.5 - 4.0. The number of S. aureus cells in the biofilm on steel plates, as well as the number of cells in the control broth, gradually decreased with decreasing pH from 6.5 to 5.5. From a pH value of 5.5 to 4.5, as shown on Figure 2, the number of cells in the biofilm surprisingly began to increase up to the highest value achieved. At pH 4.0 cells began similarly, as at the threshold value of aw 0.84, which already inhibited their growth in planktonic form, to group and form a biofilm, which represents protection for them from adverse environmental conditions, including low pH value. When the pH was reduced to pH 4.0, the number of S. aureus cells in the biofilm

rapidly decreased by up to 51.1%, which may be related to the fact that the concentration of inhibitory lactic acid exceeded the tolerable value for biofilm formation.

By comparing biofilm formation in individual isolates, different trends can be observed when pH was reduced from 6.5 to pH 6.0, when S. aureus 14733 biofilm formation was reduced by only 3.2%, but the pH reduction in the case of isolate S. aureus 2064 contributed to an increase in biofilm formation by up to 10.8%. The same trends can be observed with a decrease in pH from 6.0 to 5.5, when biofilm formation in both isolates decreased, and an increased biofilm formation was also observed in both isolates with a decrease in pH from 5.0 to pH 4.5. For both isolates, the lowest biofilm formation was observed at pH 4.0, and the number of cells in the biofilm was 3.2% higher for S. aureus 14733 than the amount of biofilm formed by S. aureus 2064.

As the pH value decreased, the ability to form a biofilm on plastic material of the isolate S. aureus 14733 and 2064 also decreased. The highest amount of biofilm was formed at pH 6.5 and was up to 2.2-times or 5.3-times higher than the amount of biofilm that corresponded to the lowest value, which was measured at pH 4.0. Surprisingly, however, the lowest amount of biofilm formed by 14733 isolate was only 7.62% lower than that of the strong producer P. aeruginosa but 2.4 times higher than that of the biofilm formed by S. aureus CCM. The highest decrease in biofilm formation was achieved by lowering the pH value from 5.5 to 5.0 and represents a difference of up to 31.5%. Compared to the control, the highest amount of biofilm formed by isolate 2064 was only 2.4% lower than the amount of the biofilm formed by the CCM strain, however, the amount of biofilm formed by P. aeruginosa was 2.5 times higher than that formed by its intermediate producer, isolate 2064.

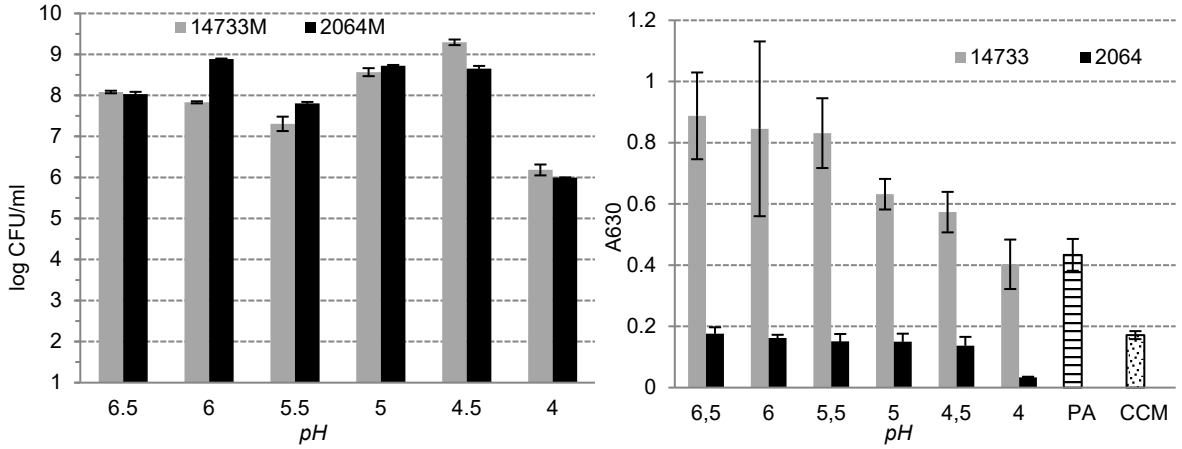

Fig. 2 Effect of pH on the biofilm formation by S. aureus on stainless steel plates and on plastic material at 37 °C

Biofilm formation affected by water activity and pH value combination

The dependence of combined effect of pH and aw (pH 6.0; 5.5. and 5.0 and aw 0.99 and 0.97) on the formation of biofilm on stainless steel is shown on Figure 3. The number of cells in the biofilm formed by isolate S. aureus 14733 at pH 6.0 and the lowest salt addition reached a level higher than 7.5 log CFU/ml. However, it is interesting that the reduction of aw value from 0.99 to 0.97, led to the increasing of cells in the biofilm to 8.17 log CFU/ml. The number of cells in the biofilm of isolate S. aureus 2064 also increased, but this difference was not so visible. At pH 5.5, the number of S. aureus 14733 cells in biofilm, on the contrary, decreased with increasing addition of salt to the medium, from 7.82 log CFU/ml (at aw 0.99) to 6.54 log CFU/ml (at aw 0.97). The numbers of cells of second isolates in biofilm also slightly decreased. At pH 5.0 and aw 0.99, the number of cells forming the biofilm of isolate 14733, compared to their number at pH 5.5 and the same aw, significantly decreased to a value of 5.30 log CFU/ml, but with a decrease in aw to 0.97, the number of cells of isolate 14733 forming a biofilm increased by 8%. The numbers of S. aureus 2064 isolate in biofilm gradually decreased to the lowest value 6.11 log CFU/ml at pH 5.0 and decreasing aw value.

When comparing the ability of S. aureus 14733 to form a biofilm on plastic and on stainless steel, the same trends can be observed due to changing environmental factors. At pH 5.0 and changing aw from 0.99 to 0.97, biofilm formation decreased in both cases, but a much larger difference can be observed on plastic. At pH 5.5, biofilm formation decreased with decreasing aw, but the intensity of biofilm formation was higher than at pH 6.0. On stainless steel, biofilm production increased slightly with decreasing aw value, but the biofilm at pH 6.0 and aw 0.97 was stronger than at the same aw and pH 5.5. At pH 5.0, when aw was reduced from 0.99 to 0.97, biofilm formation increased significantly and reached the highest value. However, at pH 5.0 and aw 0.97, among all monitored factors, biofilm formation on stainless steel was the lowest, and on the contrary, when plastic was used, it was the highest. Analysing the ability of isolates to form biofilm on plastic material in dependency on combined factors effect, it can be concluded that the absorbance values achieved at the combination of both monitored factors lower values than those achieved with their solo action, the combination of factors had the most negative effect on the formation of biofilms.

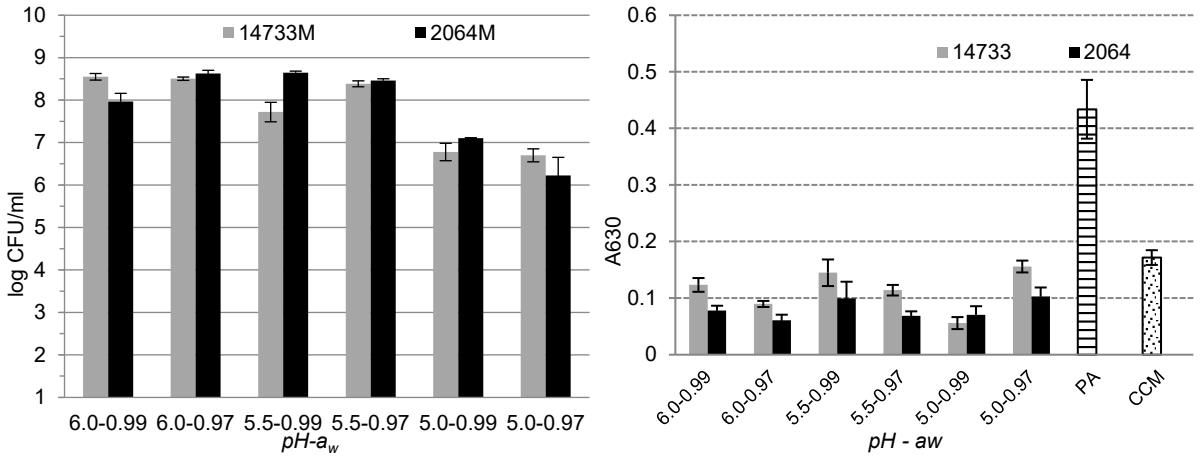

Fig. 3 Effect of combined effect of pH and aw on the biofilm formation by S. aureus on stainless steel plates and on plastic material at 37 °C

This fact is also evident when comparing the ability of the studied isolates to form a biofilm and P. aeruginosa, which at a temperature of 37 °C and the solo action of the selected factors formed a biofilm comparable to the biofilm formed by isolate 2064 and even weaker than the biofilm formed by isolate 14733. In the joint action of both factors, however, clustering of P. aeruginosa cells, or of the S. aureus collection strain was up to 64% or 10%, respectively, more intense than that of the strongest biofilm (formed by isolate 14733 at pH 5.0 and aw 0.973). In addition, P. aeruginosa formed more than 4.22% higher amount of biofilm than the highest amount of biofilm formed by isolate 2064 at this temperature.

Conclusion

Based on the results, there were statistically insignificant differences ($p < 0.05$) in biofilm formation by both S. aureus isolates on two types of stainless-steel plates. The biofilm formation was promoted with salt addition up to 5 % by both isolates and at both temperatures. With further decrease of aw, the ability of S. aureus to form biofilm was reduced. However, the biofilm formation was noticed also at a value of aw of 0.855 on both types of contact materials. With decreasing of the pH value, the biofilm formation was decreasing and inhibited at pH 4.0. Combinations of both factors (pH and aw) did not increase the inhibition of biofilm formation but by using aggressive combination of factors, better results can be obtained. The most effective way to inhibit biofilm formation on both materials is a rapid reduction of the pH down to pH 4.0 where the number of cells in biofilm will be less than 6 log orders.

In addition, based on the above conclusions, it would also recommend storing slightly salted (up to 5% NaCl) foods in glass containers, as cells of the potentially pathogenic S. aureus can be trapped in the pores of plastic containers, as well as on stainless steel surfaces. From the food production point of view, if the addition of lactic acid is used, acidification of products close to pH values 4.0 as quickly as possible should be achieved. By this approach the desirable inhibition of cell aggregation on surfaces made of plastic or stainless steel could be achieved.

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ORGANISATION OF ANANALYTICAL AND MICROBIOLOGY LABORATORY IN A POLISH MULTISPECIALITY HOSPITAL IN THE ERA OF THE COVID-19 PANDEMIC – OWN EXPERIENCE

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Abstract

Laboratory medicineis one of the most import ant sources describing a patient's health status. The time of the pandemic, forced the implementation of various procedur es that allowed the laboratory to work safesy under an increased sanitary regime. On the one hand, giving a great er protective umbrella to the Staff than before, and on the other hand, it has allowed no patient to limit the availability of the tests performed. It became imperative to ensure that the new way of working in the laboratory would to optimise the analytical and microbiological diagnostics performed and to prepare for the new epidemic conditions. Laboratory staffing was adjusted to the changed working conditions, many innovative solutions were introduced in the laboratory infrastructure, and the availability of the necessary reagents and laboratory apparatus, personal protective equipment and disinfectants was secured. All of this has made it possible to put the patientat the centre of attention in order to treat and care for him or her in a modern and safeway.

Keywords: medical diagnostic laboratory, laboratory management, research process, COVID-19

Introduction

Medical laboratory is a complex network of connections of organizational, personnel and equipment structures operating in the widely understood health care. Functioning and operation of diagnostic laboratories is secured by legal regulations, standards, rules and norms developed especially for this area. Quality is an extremely important issue in the world of diagnostics and laboratory services, as demonstrated by the COVID-19 pandemic, highlighting the work of

laboratory diagnosticians on behalf of patients requiring specific types of tests to detect, directly or indirectly, the SARS-CoV-2 virus. This paper presents our own experience in setting up a special laboratory for the detection of SARS-CoV-2 infection for the Hospital Emergency Department, Modular and Temporary Hospital and routine laboratory diagnosis for such patients.

The first case of SARS-CoV-2 coronavirus infection in Poland was reported on March 4, 2020. It happened less than 5 months after, in November 2019, the first cases of atypical pneumonia began to be registered in the Chinese province of Hubei. In the city of Wuhan already at the end of December 2019 a report was published describing patients with atypical pneumonia of unknown etiology. Since then, gradually infections with a new type of coronavirus, initially referred to as 2018-nCoV and then SARS-CoV-2, began to spread to other countries, and the COVID-19 pandemic has spread across the globe. Medical laboratories faced the need to launch new facilities focused on the diagnosis of SARS-CoV-2 infection. According to the recommendations of the World Health Organization, the optimal method of virus detection was molecular tests performed with the real-time PCR technique in real time, which allowed to detect the genetic material of the virus in a sample taken from a patient. Next, antigen tests were introduced to detect the SARS-CoV-2 antigen in human nasopharyngeal swab samples taken from individuals who met the clinical or epidemiological criteria for COVID-19.

The Department of Laboratory Diagnostics of Central Clinical Hospital of Ministry of National Defense, Military Institute of Medicine carried out analytical tests for patients in almost 1000-bed hospital, where approximately 150 people were admitted daily to HED patients (Hospital Emergency Department). Benefits of the so-called hospital care is a comprehensive 24-hour assistance that includes not only medical care but also the executing of laboratory tests. In the era of a pandemic, it was a logistical and substantive challenge for a multidisciplinary laboratory. Rapid molecular tests (waiting time for the result up to 1 hour) and antigen tests were performed in the central laboratory. Routine molecular diagnostics for the detection of SARS CoV-2 RNA was carried out in the laboratory of the Department of Clinical Transfusiology, Central Clinical Hospital of Ministry of National Defense, Military Institute of Medicine.

COOPERATION BETWEEN A LABORATORY DIAGNOSTICIAN AND A CLINICIST DURING COVID 19 PANDEMIC

The flow of information between a clinician and a laboratory diagnostician is essential not only for a correct diagnosis, but also for treating a patient suffering from COVID-19. Before an order

for a laboratory test is issued, the doctor should ask himself/herself what laboratory tests are necessary to make a diagnosis. To facilitate the cooperation between the doctor and the Medical Diagnostic Laboratory (MLD) as to guarantee correct procedure, the rules of collecting material for testing and transport shou

in the procedures and should be known to doctors cooperating with MLD. Below, there are some examples of analytical and microbiological procedures that are used at the Central Clinical Hospital of the Ministry of National Defense, Military Institute of Medicine and have been prepared or updated during the pandemic.

ANALYTICAL AREA OF RESEARCH	
PR03_PP02_1.2	Collection of material for laboratory tests
PR03_PP02_1.3	Transport of material for laboratory tests
PR03_PP02_1.4	Acceptance, registration, labelling of material for laboratory research
PR03_PP02_1.11	Issuing the results of laboratory tests
PR03_PP02_1.12	Handling of criticalresults
PR03_PP02_1.13	Implementation of a new laboratory test for routine determination
PR02_PP03_IR46	Taking swabs for tests to detect genetic material of 23 pathogens
PR02_PP03_IR47	Collection and delivery to ZDL of special materials for analytical and microbiological tests collected from COVID + patients
PR02_PP03_IR48	Collecting and delivering to ZDL materials from patients treated in the Temporary Hospital
MICROBIOLOGICAL AREA	
PR03_PP02_P7.1	Ordering a microbiological test
PR03_PP02_P7.6	Collection, storage and transport of materials from the upper respiratory tract for microbiological testing
PR03_PP02_P7.7	Collection, storage and transport of materials from the lower respiratory tract for microbiological testing
PR03_PP02_P7. 17	Receipt, registration and laboratory marking of material for microbiological tests
PR03_PP02_P7.18	Receipt and storage of materials for microbiological tests at ZDL

The optimal preparation of information in the form of procedures is extremely important as it is assumed that up to 80% of medical decisions are based on laboratory results. Laboratory tests

are a source of information/confirmation for a physician whose task is to correctly diagnose the disease and implement appropriate treatment that has caused so many problems in COVID-19 patients. A diagram showing cooperation with doctors of COVID wards on the part of laboratory diagnosticians is presented in Figure 1.

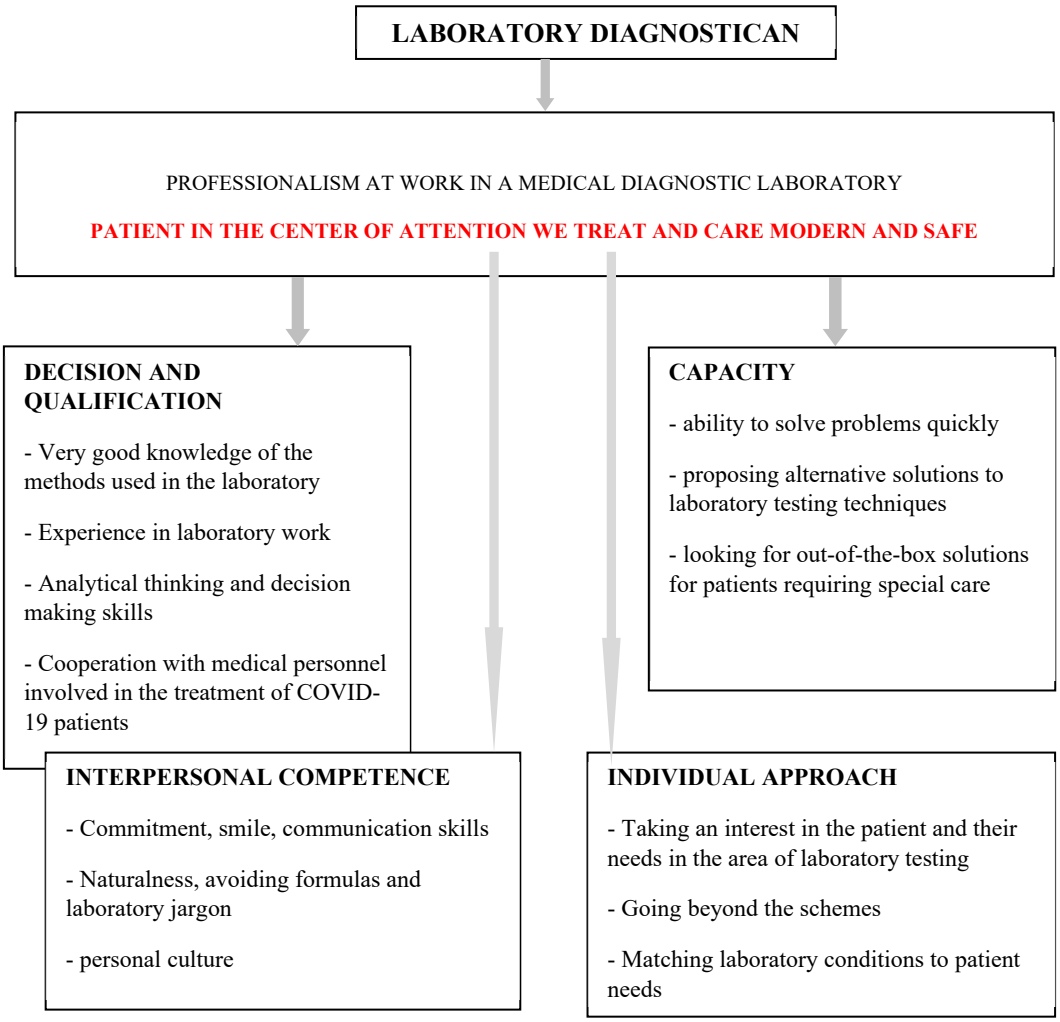

Fig. 1 Cooperation of laboratory diagnosticans with clinicists for COVID -19 patients during pandemia

Own compilation

There are several areas of cooperation between a doctor and a laboratory diagnostician. They include:

- proper selection of the research panel
- the waiting time for the result - ideally it should be as short as possible
- method of reporting the result (electronic version in the hospital system / electronic medical documentation)

- correctness of the pre-analytical phase - analysis and exclusion of errors. Pre-laboratory errors can account for up to 70% of all laboratory test errors)
-selection of the optimal analytical method
- result obtained - its units - comparison to reference values.

The list of tests necessary for immediate medical intervention should be developed in cooperation with a laboratory diagnostician. These tests should be clearly marked. Our proprietary solution was to introduce different coloured codes on orders and test tubes. This allowed for the introduction of the optimal way of carrying out the research and had a positive effect on the time of issuing the results. Samples with red codes are *cito* tests, the entire area of the emergency department and all urgent samples from all clinics and departments work based on such code colours. Yellow codes are reserved for cancer patients. Orange codes for additional tests are still functional, for routine tests – the codes on white stickers are assigned. This system eased all cooperation and found many supporters among doctors and nurses.

AUTOMATION IN A MEDICAL LABORATORY AND SUPERVISION OF EQUIPMENT IN A SPECIAL LABORATORY in ZDL CSK MON WIM

In the era of dynamic development of computerization in everyday life, also in MDL automation is a necessity and the basis for functioning. Recent years have shown, in the face of the pandemic, that in a medical laboratory, widely understood computerization is necessary, especially when laboratory personnel also struggled with SARS CoV-2 infection. Automation in the laboratory allows to reduce the number of errors resulting from human work, it also reduces the costs of reagents through better precision and accuracy of the device. This procedure allows the procedures to be carried out in much smaller reaction volumes, which significantly reduces the amount/volume of material necessary for the test. The need to standardize the analytical procedures for automatic devices used in MLD allows for comparative assessment among other laboratories operating on the same devices (external laboratory controls). In the era of shortages of human laboratory diagnosticians, the introduction of automatic devices provides some protection for the continuity of work, but it should be remembered that no device in the laboratory can work without the supervision of professionals, so automation is helpful, but only in the hands of qualified laboratory medical services.

In order to properly supervise each device in the laboratory, it is necessary to divide the equipment into strategic equipment, measuring equipment, auxiliary or additional equipment. Therefore, in order to perform the test, it is required to use both a strategic analyzer, e.g. for

coagulation determinations, and an auxiliary device such as a centrifuge or a measuring device such as an adjustable pipette. Each equipment is inventoried. ZDL CSK MON keeps a register of equipment in the form of device folders, which include documents regarding the purchase or lease, installation, inclusion and principles of operation, maintenance, calibration, technical passport, etc.

All the developed rules and criteria for the operation of the equipment in the special laboratory are described in general procedures and instructions. Each activity in this area has been documented with relevant records confirming the performance of the analysis in accordance with the established specified requirements, which enable the reproducibility of the research process. Thisisa proof of MLD'stechnicalcompetence [5].

OPTIMIZATION OF ROOMS DESIGNED FOR LABORATORY ACTIVITIES DURING THE COVID-19 PANDEMIC

The Laboratory Diagnostics Department of the Central Clinical Hospital of Ministry of National Defense, Military Institute of Medicine has almost 1000 m2 of laboratory space, a modern analyzer park and a team of almost 70 working employees: laboratory diagnosticians and medical analytics technicians. From the beginning of work with the material collected from the first COVID-19 patients treated in the hospital, a number of steps have been taken, which quickly turned into laboratory quality procedures to protect all working laboratory personnel against SARS CoV-2 infection during diagnostic activities. In the era of a pandemic, in addition to the increased sanitary regime introduced throughout the Institute, a special zone was additionally designated in the laboratory, in which all tests available in the ZDL menu were performed for patients suffering from SARS CoV-2 coronavirus infection. The personnel working in rotation in this place were additionally secured with appropriate personal protective equipment, such as Tyvek suits, goggles, helmets, etc. It was also ensured that the material collected from this type of patients was not submitted to the general registration of the Institute. For this purpose, a special sluice-type serving window has been prepared. In the special part of the laboratory, video monitoring was installed so that from the outside, from the main corridor of the laboratory, it was possible to control the work of people working in the area of particular risk of infection. These are solutions transferred from laboratories with a higher level of bio-safety, eg BSL3 (bio-safety level 3). An organizational chart of the changes made is shown in Figure 2. The entire laboratory area was additionally equipped with flow-through UV lamps. In addition to the distributors with hand disinfectants in each room, special absorbent mats soaked in a chlorine-based shoe disinfectant have been placed at the entrance / exit to the

laboratory in order to minimize the exposure of personnel to infection with the pandemic type of coronavirus as effectively as possible.

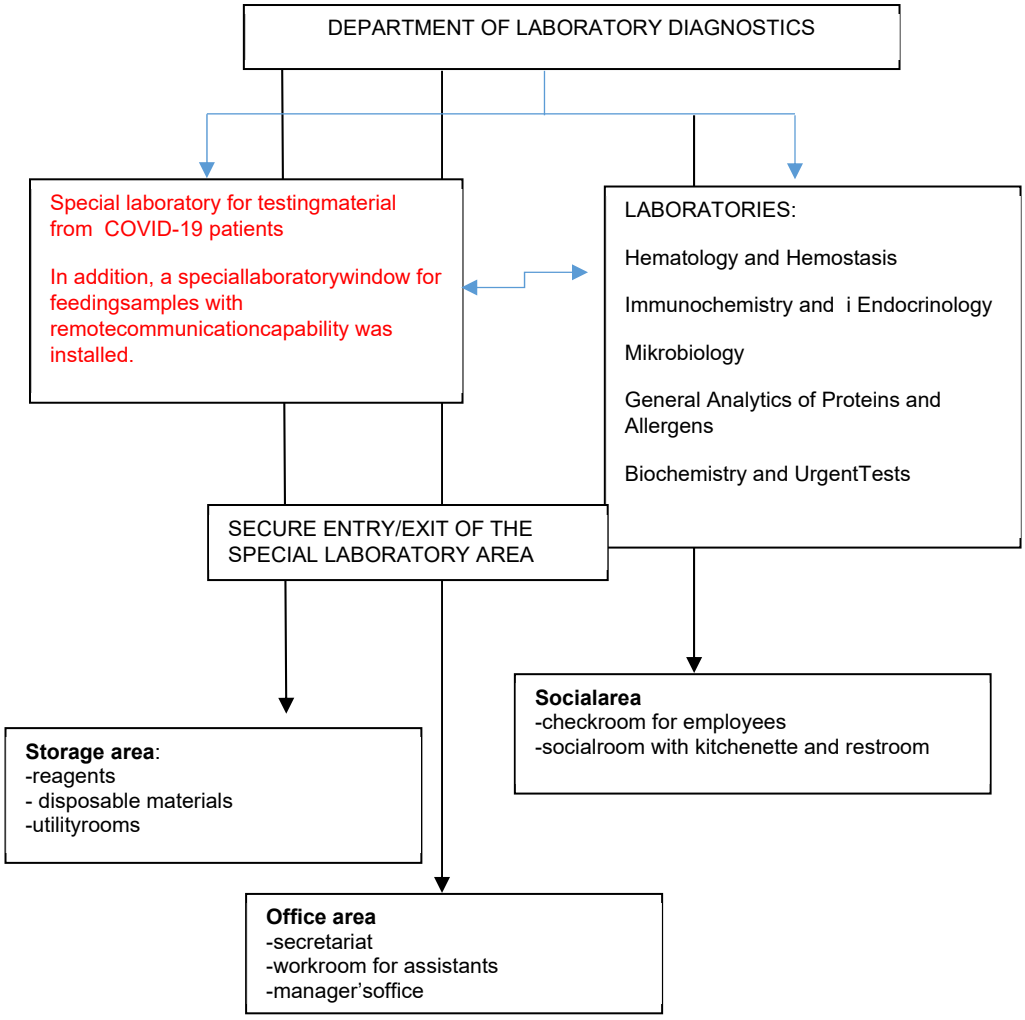

Fig. 2 Diagram showing the interrelationship of laboratoryrooms with laboratory test at the Department of laboratory Diagnostics of Central Clinical Hospital of Ministry of National Defense, Military Institute of Medicine in Warsaw/Poland

Conclusion

As a result of the COVID-19 pandemic, the major health problems of the entire human population were verified and assessed again. There were shortcomings in the functioning health care system, including the proper adaptation of routine diagnostic laboratories providing services to patients in the hospital concerned with such tests. This situation helped to understand that there is a need for globalization of medicine, including laboratory medicine, and the need

to urgently build solutions and implement clear strategies for the entire laboratory environment. Laboratory diagnostics has so far played a key role in this fight. In order to detect the disease, it has become necessary to detect the presence of SARS-CoV2 virus particles in respiratory swabs. Similarly to confirming a cure, a negative result was required on the basis of the material delivered to the laboratory. The Military Institute of Medicine is a dynamically developing multi-profile research and treatment unit, and its structures also include modern laboratories equipped with the most modern laboratory equipment. In our laboratories, we promote innovative solutions, including those related to digital transformation, which plays a key role in communication between the patient and doctor - laboratory diagnostician. It was especially important in the era of the pandemic, where the quality of services, not only laboratory services, translated into therapeutic success for the patient.

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PROSPECTS FOR THE USE OF THREE-DIMENSIONAL VIRTUAL REALITY (VR 3D) SUPPORTED BY ARTIFICIAL INTELLIGENCE (AI) ALGORITHMS IN MEDICAL EDUCATION

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Abstract

Three-dimensional virtual reality (VR 3D) is a three-dimensional image created using information technology and additional accessories, which imitates the real world or is a vision of a fictional world. A technique based on 3 I is used, that is: *Interaction, Immersion* and *Imagination*. Thanks to the use of virtual reality (VR) and augmented reality (AR) technologies, learning is faster and more effective at every educational level. Augmented Reality (AR) is a system that connects the real world with virtual reality by combining the image from the camera with a 3D computer-generated image. Separation in 3D virtual reality gives you the chance to fully get to know and concentrate on the discussed issue. The necessary equipment is: 3D glasses, stereoscopic 3D image display, giving the impression of spatiality, manipulators, VR goggles with a touch controller and an advanced audio system. The generated image is superimposed on the glasses display (HoloLens, Oculus, Varjo etc.) through which the real world is observed. Control is carried out by tracking the movement of the eyeballs, by voice or by using the hand gestures of the controllers. New technologies based on virtual reality (VR 3D) are an opportunity to improve the quality and effectiveness of training and increase the number of trained medical personnel. These methods can be used as a didactic tool in education at any level of education, including during the internship of students: physiotherapy, medical, nursing, cosmetology, in aesthetic medicine clinics and during the implementation of improvement courses, postgraduate courses for health professionals. It is the future of the education standard, surgical planning, surgical operations in AR technology, diagnostic standard and visualization of procedures for the patient.

Keywords: artificial intelligence, augmented reality, education, medicine, virtual reality

Introduction

Teaching is a complex process based not only on the transfer of knowledge to students but also on influencing students in such a way as to arouse interest in the discussed issue, readiness and willingness to learn [Schiel and Everard, 2021]. It is important that the students are active during the teaching process [McCoy et al, 2018]. Achieving this is possible thanks to appropriately selected and applied teaching methods [Wolf, 2004]. Education of students today is not one of the easiest tasks due to the saturation of information and easy access to sources via the Internet. Currently, the role of the teacher is not only to impart knowledge and teach learning methods, but above all to indicate reliable and peer-reviewed scientific sources [Cook and Reed, 2015]. In addition, teachers should teach students how to search for reliable information. They will often make clinical decisions based on their knowledge. Acquiring clinical skills during your studies is one of the most important elements of quality education [Wells et al., 2021]. In addition to the general scheme of examining a patient: watching, touching, tapping, auscultation or undertaking nursing and rehabilitation processes, students should learn to show empathy and respect for the patient [Batt-Rawden et al., 2013].

The time of acquiring knowledge only from textbooks and transferring knowledge only during lectures, seminars, laboratories or clinical classes is over. Although the teaching of medical subjects is still based on traditional methods, more and more medical universities introduce innovative teaching technologies in medicine using virtual techniques [Kyaw et al., 2019]. The use of virtual reality together with artificial intelligence is the future and an opportunity to better remember new material from a given medical department and, above all, to improve the quality and effectiveness of education at every stage of education [Chen et al., 2020].

Teaching models

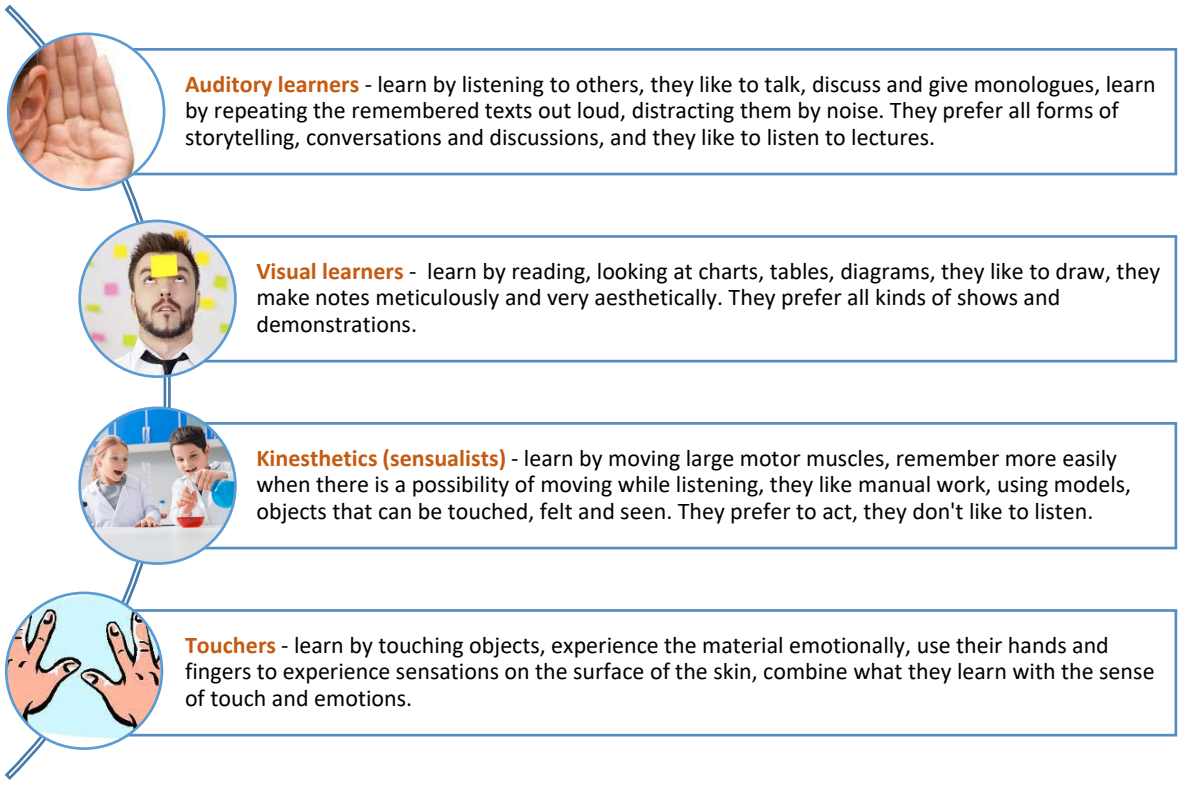
The choice of teaching method often depends on the individual predispositions of the teacher and students. Due to individual differences in the learning process, each person should use different teaching techniques that will affect the sphere of hearing, sight, touch and feeling. [Sivarajah et al., 2019]. Many teaching models have been developed and are used at every stage of education [Chamorro-Premuzic et al., 2007].

Teaching models [Sivarajah et al., 2019]:

searching	•creative problem solving, creating problem situations
direct	•focuses on procedural knowledge
teaching concepts	•teaches logical thinking
giving	•passing on knowledge: story, lecture, description, talk
curriculum	•based on the curriculum, using a book, computer, etc.)
exposing	•show with survival elements
practical	•project method, laboratory exercises

Teaching methods should be appropriate to the abilities of learners who often represent different learning styles.

Learning styles [Panfil, 2013]:



Dale's Memory Pyramid

According to the diagram developed by Dale (Figure 1), it shows that the average student remembers the most information during active teaching of other people, and the least by passively participating in the lecture. Active forms of teaching, such as: practical classes, didactic games, group discussions, demonstrations are the most effective forms of teaching [Wang et al., 2018].

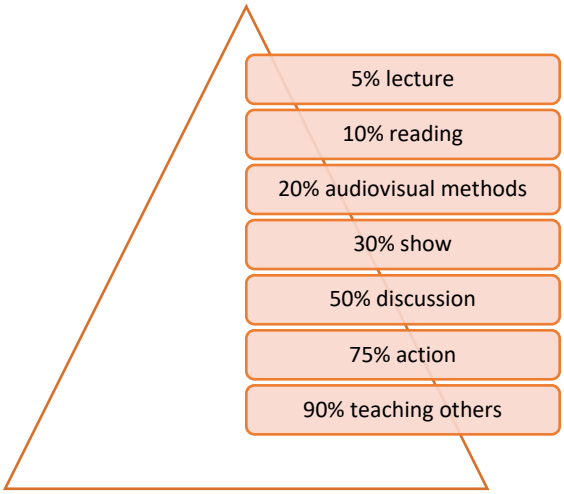
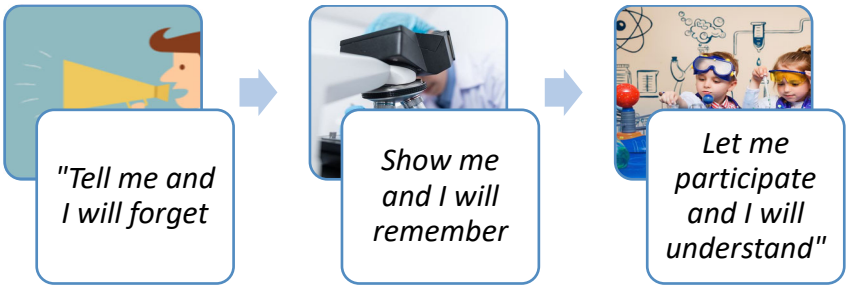


Fig. 1 Dale's Memory Pyramid [Wang et al., 2018]

Activating methods in teaching

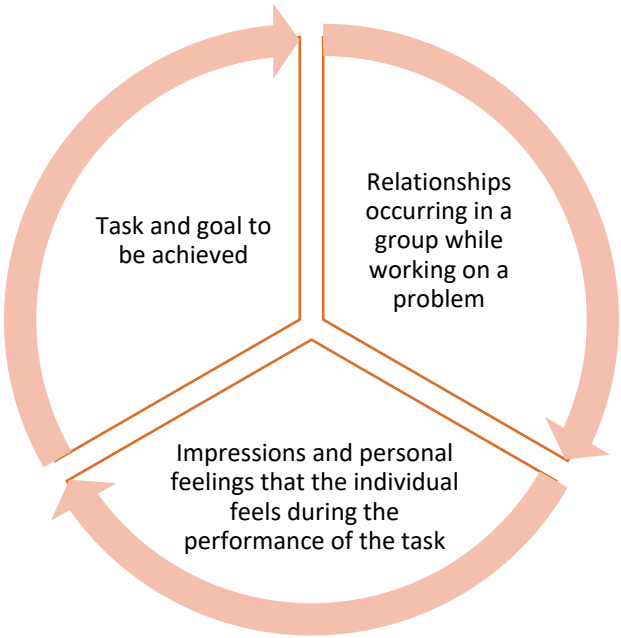
They are the most effective and effective teaching methods [Raiola et al., 2022]. Transferring and assimilating knowledge takes place in an unconventional way. All classes should motivate medical students not only to take action but also to think creatively and solve clinical problems creatively. It is based on action through experiencing and teaches cooperation in a group [Johnsen et al., 2018; Alberti et al., 2021].

The essence of activating methods can be summed up in the proverb of the Chinese philosopher Confucius [Keenan and Chew, 2020]:



In addition, a continuation of this philosophical thought is another saying by Confucius: *"Our potential increases because if the mind is stable, we become calm, when we are calm, we can think and eventually achieve our goal."*

Three levels of communication when using activating methods [Alberti et al., 2021]



The use of activating methods in teaching medical subjects allows for better preparation of students to work in a team, not only during education but also in professional work where cooperation of specialists in various fields is required: diagnosticians, nurses, physiotherapists and doctors [Fox et al., 2018].

Virtual reality (VR) as an innovative teaching tool

The development of medicine in the field of diagnostic methods and therapy, the development and automation of 3D printing, e.g. implants, models, etc., makes it necessary to implement innovative teaching and learning strategies using three-dimensional virtual reality techniques supported by artificial intelligence algorithms - *See Figure 2-3* [Yang et al., 2021].

Virtual reality, also known as phantomics, is a group of technologies that allow people to interact effectively with three-dimensional computerized databases in real time using natural senses and skills, such as sight, hearing, touch or smell [Farshad-Amacker et al., 2022]. The advanced form of the human-machine interface allows the user to be immersed in a computer-generated environment and interact with this environment in a naturalistic way. However, in order to achieve the feeling of natural reality in an artificial world, specialized computer

software is needed that will enable interactive 3D visualization and additional accessories [Barteit et al., 2021].

Fig. 2 Three-dimensional virtual reality as a tool in surgical planning and medical education. (Own study, 2022)

Fig. 3 Human cadaver for the study of normal anatomy in VR. (Own study, 2022)

These accessories include [Tsao et al., 2022]:

HMD (HEAD MOUNTED DISPLAY) helmet - specific glasses, headphones, position control

SPECIAL DATA GLOVES - equipped with position sensors

SUITS (SMART SKIN, DATA SUITS) - equipped with many sensors, allowing for the conversion of signals from the virtual world into tangible stimuli

SENSORS CONSTANTLY TRACKING THE POSITION AND ORIENTATION OF THE USER - transmit information to the computer, which updates the displayed images in real time

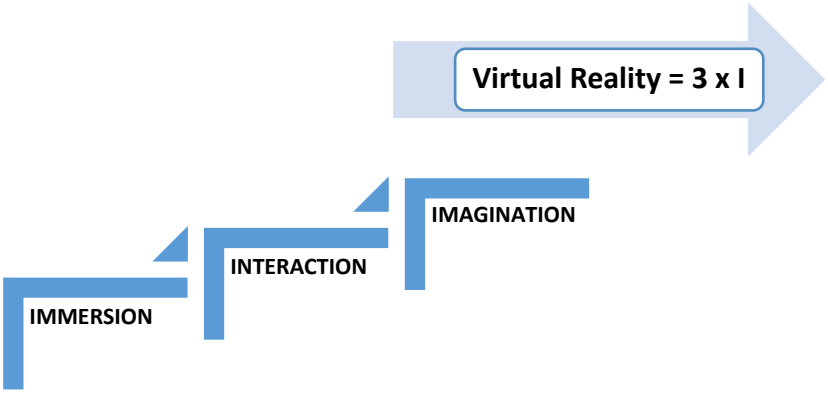
VRML - VIRTUAL REALITY MODELING LANGUAGE AND ITS SUCCESSOR X3D - describes three-dimensional (3D) graphics, interactive vector graphics

The simplest VR platform that does not require expensive and complicated hardware infrastructure was developed by Google. The above platform uses cheap and easy-to-use cardboard frames in which the smartphone is placed. In addition, these luminaires can be folded and give the possibility of using many popular models. However, more complex solutions, such as Oculus Rift or HTC Vive, require a complex hardware infrastructure. However, they are

more expensive and usually used in specially adapted rooms or specialized laboratories [Kamińska and Zwoliński, 2019].

These types of VR platforms give you the opportunity to interact thanks to built-in headsets and controllers with a set of sensors [Pottle, 2019].

The VR technology uses a technique based on 3I [Kamińska and Zwoliński, 2019]:



To achieve deeper immersion, you need to have special external sensors, such as: Kinect or MYO Gesture control band, sensory gloves or special suits equipped with multiple sensors [Kurillo et al., 2014; Sathiyanarayanan and Rajan, 2016].

3D visualization in virtual reality

Surface rendering

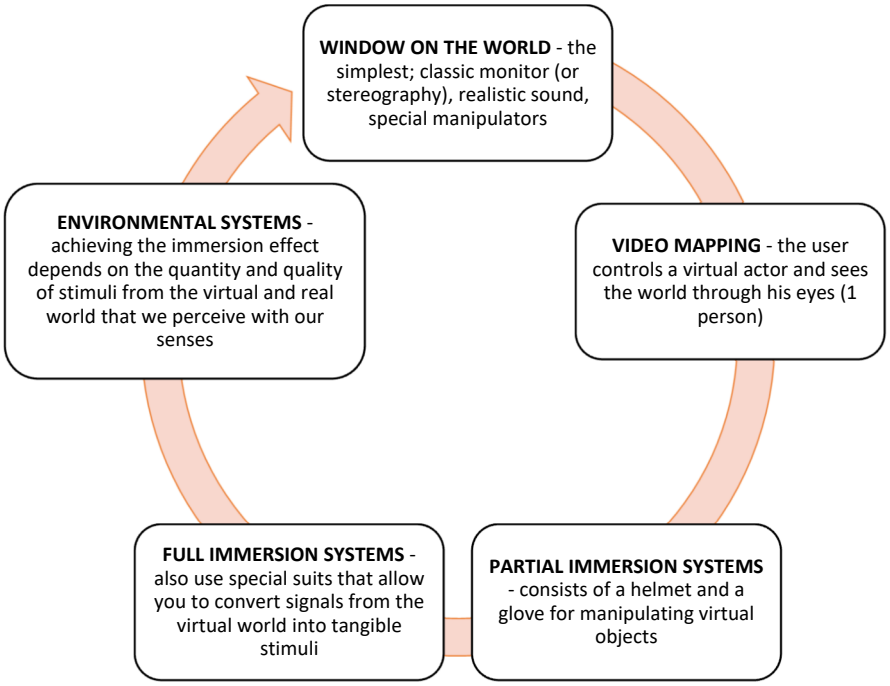
Visualization of selected isosurfaces, i.e. surfaces with constant characteristics inside the volume. Prior segmentation of selected structures is needed. Relatively fast method, but only for prepared contours. This has found application to inverse rendering based on implicit, mesh and parametric surfaces and neural network training applications. The authors of the study demonstrated efficient, differentiable rendering of isosurfaces extracted from a neural radiation field (NeRF) and demonstrated surface-based rather than volume-based rendering of NeRF [Cole et al., 2021].

Volume rendering

In this method, the entire volume is used, i.e. all voxels are characterized. Flexible volume exploration is possible. There is a very high computational complexity [Guo et al., 2013; Li et al., 2015]. Volume rendering (VR) is a three-dimensional (3D) image processing technique. This technology has been used in teaching medical subjects, mainly anatomy. This is used to

visualize complex anatomical information. In addition, a novel three-dimensional computed tomography (CT) image data processing technique called cinematography (CR) has recently been introduced. The cinematography used in the diagnostics with the appropriate contrast visualizes high-density structures, which ensures more natural and photorealistic lighting of the rendered data [Dappa et al., 2016].

Main types of systems [Park et al., 2019]:

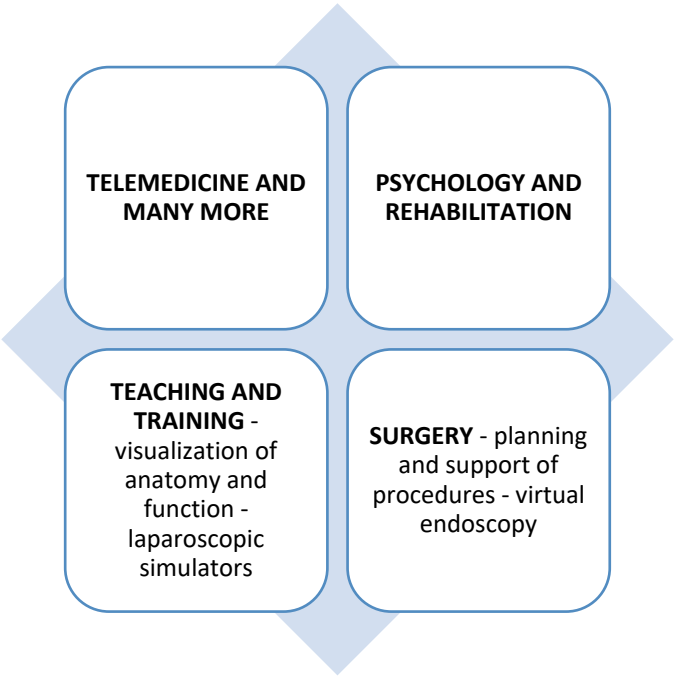


CAVE (*Cave Automatic Virtual Environment*)

The entire rooms are equipped with specialized curved screens on the walls (floor and ceiling), the shape of which makes it easier to "penetrate" into the virtual world and feel it with all your senses. The image and sound surround the person from all sides. At the same time, a group of people can participate in teaching [Maftei and Harty, 2021].

VR applications in medicine

The first applications of virtual reality in healthcare date back to the early 90s. There is a need to visualize complex medical data (especially during operations and their planning). It is estimated that only about 20% of virtual reality applications in health care use devices such as helmets or special clothes [Yeung et al., 2021].



Teaching - visualizations

Interactive, dynamic and three-dimensional visualizations have a huge advantage over classic book atlases. According to [Delaney, 2016] CyberEdge is one of the most popular techniques with huge applications in various fields.

Surgery - planning and supporting procedures - virtual endoscopy

The use of the VR method in surgery is a great technological achievement thanks to which it is possible to present virtual objects to all human senses in a way identical to their natural counterparts [Quero et al., 2019]. With the progress of information-based medical technologies, it will be possible to represent the patient very faithfully => the virtual image will become a substitute for the patient. The VR system should offer real-looking body parts that interact with external tools (e.g. surgical instruments) in a way as close as possible to their real models [Wang et al., 2018].

Planning procedures with complex anatomy using VR techniques gives the opportunity to reach the intervention site, bring manipulators, lead away - perform manipulations (removal of pathological tissue) – *See Figure 4-6*. In the case of high-risk surgical procedures performed in neurosurgery or heart surgery, this method makes it possible to avoid damage to vital organs [Wang et al., 2021].

During conventional operations, the doctor only sees the surface and movement of the scalpel, which unfortunately is not reversible. Thanks to the use of VR, the doctor can look below the surface and make decisions based on additional knowledge from other sources [Bueckle et al., 2021].

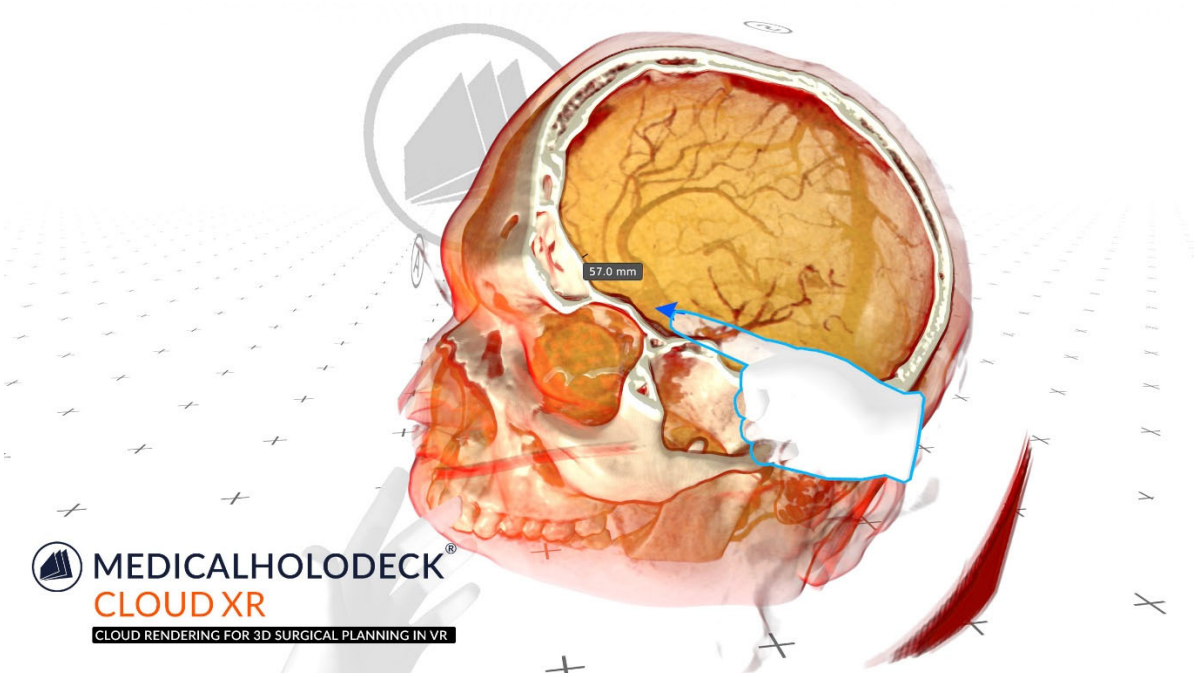


Fig. 4 Analysis of the anatomical structure of the patient's cerebral vascular system in 3D VR space prior to planned neurosurgery. 3 D angio-CT reconstruction. (Own study, 2022)

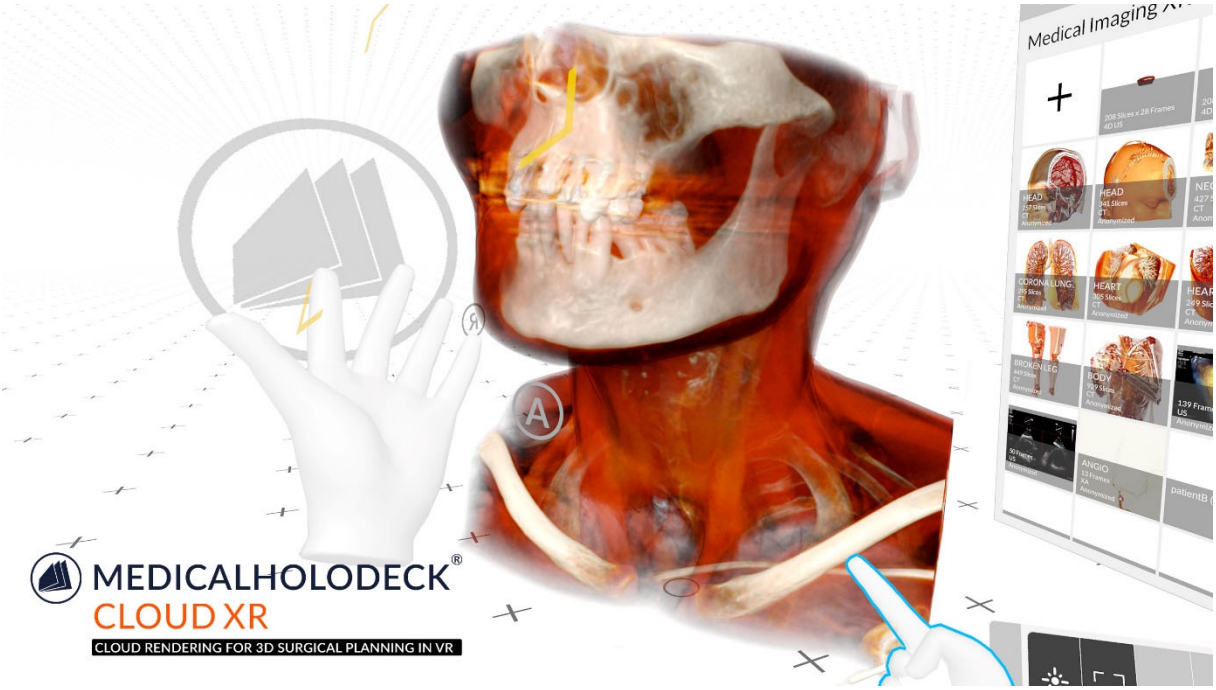


Fig. 5 3D visualisation of the head and neck for medical students. 3D reconstruction of computed tomography. (Own study, 2022)

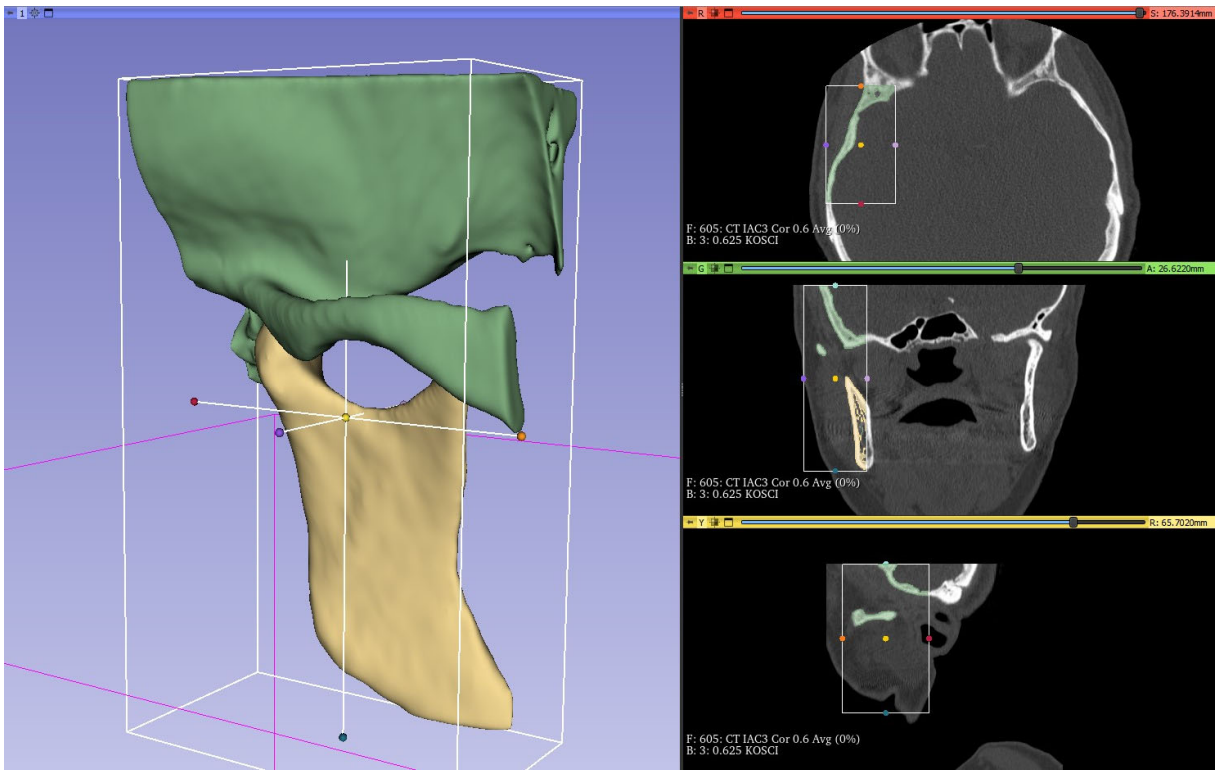


Fig. 6 Segmentation of the temporomandibular joint based on patient CT images in Slicer software. The segmented object can be used for 3D printing.(Own study, 2022)

Augmented reality - a combination of a real scene seen by the user and a virtual scene that augments (enriches) the scene with additional information. Computer generated images are superimposed on the real view. The goal is most often to improve perception [Verhey et al., 2020].

Virtual endoscopy

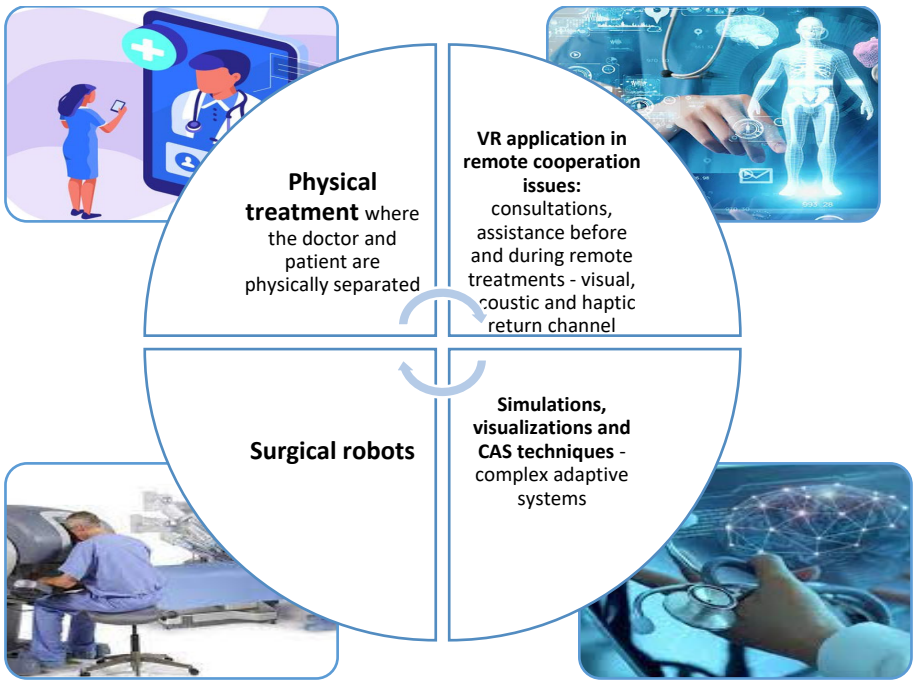
Endoscopy (e.g. colonoscopy, gastroscopy) – effective, but invasive method during which complications may occur. This method is used as a screening test for the diagnosis of cancers (colon, esophagus, stomach etc.). On the other hand, virtual endoscopy allows you to simulate a "walk" around the body, but it will not replace optical endoscopy [Mahmood et al., 2018]. The advantage of this method is: low invasiveness (only imaging), full control of lighting and direction, no physical access restrictions. The disadvantage of this method is its dependence on image quality and segmentation [İncetan et al., 2021]. Both the texture and color of the tissue are artificial. No physical interaction with tissue (no intervention possible, for example removal of pathological tissue) [Siddiqui and Aslanian, 2020].

VR - Psychology and rehabilitation

Virtual technologies are used in mental health therapies, such as: phobias, behavioral disorders. In addition, therapies are used in: orthopedics, neurology - Parkinson's disease, strokes. Training in a virtual environment or motor training is performed [Lei et al., 2019; Maggio et. Al., 2019; Karamians et al., 2020].

From the point of view of clinical psychologists and rehabilitation specialists, the goal is definitely different. They use VR to situate the patient in a computer-generated three-dimensional virtual environment. Active participation vs. external observation of images on the screen. In a virtual environment (VE), the patient has the opportunity to learn how to behave in difficult situations related to his disorders [Katzakis et al., 2020]. VEs are highly flexible and programmable. They allow the therapist to present controlled stimulations (e.g. anxiety situations) => measurement and monitoring of the user's responses. Systematic strengthening training and transferring behaviors to the real world [Harris et al., 2019].

Telemedicine



Conclusion

Three-dimensional virtual reality (VR 3D) supported by artificial intelligence (AI) algorithms has found its application especially in medical teaching. One of the basic and most important subjects in the education of medical students is anatomy. This subject is a discipline in which spatial visualization is important. Pupils or participants of post-graduate courses, specialization

courses, improving medical staff have the opportunity not only to learn the structure of individual organs and their anatomical functions in the context of the functioning of a given system, but also spatial relations with the surrounding structures. This technology allows to expose the three-dimensional (3D) dynamics of anatomical structures, for example the kidney or lungs, which is not provided by classic anatomy textbooks and anatomical atlases.

VR methods can be used as a teaching tool in education at every level of education, including student internships: physiotherapy, medicine, nursing, cosmetology, in aesthetic medicine clinics and during the implementation of improvement courses, postgraduate courses for healthcare professionals. This is the future of the standard of education, planning and performing surgical operations in AR technology, the standard of diagnostics and visualization of treatments for the patient. Virtual reality is still a very active field of research, but it can still be a real tool in some medical applications. Dissemination, however, requires overcoming many barriers, primarily financial. With more advanced tasks, the most difficult is to create models (objects, events, interactions) close to reality. Most often, highly realistic visualization is no longer the biggest problem. In surgical applications, issues related to direct interaction with virtual objects (touching objects, their deformations, etc.) are particularly difficult.

New technologies based on virtual reality (VR 3D) are an opportunity to improve the quality and effectiveness of training and increase the number of trained medical personnel.

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