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Original Research

Development of a Unified Methodology for Risk-oriented Sanitary and Hygienic Monitoring of Advisory and Diagnostic Health Care Centers

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Nowadays, there are crucial issues for sanitary and hygienic monitoring of activity risk assessment of the health care facilities for identify internal and external factors occupational conditions of health risk development for medical workers and patients in health care facilities. The objective of the study was to develop a methodology for risk-oriented monitoring of health care facilities, taking into account the classes of working conditions of medical staff. The development of the unified methodology of the risk-oriented monitoring of the health care facilities' activities taking into account the classes of working conditions of the medical staff and sanitary and technical provision made it possible to establish that the greatest probability of the risk and health hazard development for the medical staff in the advisory and diagnostic health care centers was represented by intellectual, sensory and emotional loads (working conditions classes - 3.2, 3.3) as well as by the biological factor (3.4) with thefinal identification equal to 16 scores, which corresponds to a high risk level (red); the identification of the probability of risk and impairment to health by the hardness of the work process (3.2) is set at 9 scores - medium risk (yellow), and by the parameters of the microclimate, regardless of the period of the year (3.1), corresponds to 6 scores - low risk (green).

Introduction

The relevance of the development of advisory and diagnostic health care as a specialized form of medical care to the population, providing an effective diagnostic system and contributing to improving the availability and quality of treatment and diagnostic health care, taking into account the modern diagnostic potential, is presented in several publications, where the need to develop this direction to strengthen the diagnostic potential of outpatient - polyclinic medical facilities of primary health care is noted [1-5].

The importance of early and quality diagnostic medical care is associated with health care safety, which is the epidemiological safety of medical technology and the medical environment. The WHO World Alliance on Patient Safety, under the auspices of Clean care is safer care dedicated to preventing healthcare-associated infections (HCAI). The main goal of the WHO World Alliance on Patient Safety is to strengthen the attention of country leaders on the vital role of hygienic

foundations for the safety of health care, highlighted by the Alliance as a global challenge [6, 7]. The period of the COVID 19 Pandemic epidemiological crisis most clearly demonstrated the need for hygienic conditions and hygienic measures in preventing the spread of many infectious diseases, including coronavirus infection [8-10]. As a result of the reforms carried out in the republic's health care system, innovative processes of accelerated development of medical technologies and material and technical equipment of the health care facilities were observed. However, all this requires continuous improvement of measures to identify, prevent and minimize risk factors. In this connection, for sanitary and hygienic monitoring of activity risk assessment of the health care facilities, it is necessary to identify internal and external factors forming conditions of health risk development for medical workers and patients. Furthermore, for the effectiveness of sanitary and hygienic monitoring of the health care facilities' risks, it is necessary to thoroughly analyze the identified risk factors and determine areas of their most significant and most minor concentration (mapping). It makes it possible to designate zones on a particular territory for a first-priority response.

Materials and Methods

We have drawn up a scientific basis for monitoring health risks of the activities of the health care facilities using as an example of the advisory and diagnostic health care centers, which were located in the Tashkent city Karakalpakstan, Bukhara, and Qashqadaryo regions. Eco and hygienic certification, which we have developed, formed the basis of methodological approaches for the sanitary and hygienic monitoring of the risk assessment of the advisory and diagnostic health care centers activities. According to international standards ISO 9001:2018, one of the first tasks for preventing risk development is identifying existing risks based on introducing the concept of "risk-based thinking" [11].

An assessment of risk probabilities and possible impair to the medical staff and patients' health was carried out for risk identification and critical analysis of the advisory and diagnostic health care centers' activities.

Based on the international experience, we developed an algorithm of risk identification, which includes four stages. The first stage of risk identification was risk probability assessment. The second stage was the assessment of possible consequences or impair to medical staff and patients' health in the health care facilities. The third stage was the development of a risk cluster matrix, based on the class of the working conditions of the medical staff and the sanitary and technical provision of the health care facilities. The methodology of three-dimensional measurement of the probability of risk and consequences of the impact of production factors on medical staff and patients' health (impair) was used in compiling the risk assessment matrix. Developing a three-dimensional risk matrix involves assessing the probability of risks with a gradation of qualitative assessment - high, medium, and low levels of possibility in combination with a quantitative evaluation according to a scoring system - from 1 to 5 score. The fourth stage - making a risk assessment map, taking into account classes of working conditions and sanitary-technical provision.

Results and Discussion

There was created a risk register taking into account the classes of working conditions of medical staff, which is possible in the activity of the health care facilities to make the risk identification process effective. These risks can contribute to the development of occupational-conditioned diseases of medical staff. The gradation of risk probability with an account of classes of working conditions for the advisory and diagnostic health care centers staff is given in Table 1.

Working conditions		Risk probability	
class gradation	class	risk gradation	score
Optimal	1	no	0

Permissible	2	very low	1
Harmful	3.1	low	2
Harmful	3.2	medium	3
Harmful	3.3	high	4
Harmful	3.4	high	4
Dangerous	4	very high	5

Table 1. Risk Probability Gradation Concerning classes of Working Conditions for Medical Staff.

Each class of working conditions has its level of risk probability in qualitative and quantitative terms according to the gradation of risk probability presented in the table. Quantitative risk assessment allows us to assess the degree of danger, threats to medical staffs' and patients' health of the advisory and diagnostic health care centers in scores. The determination of risk probability taking into account the classes of working conditions for the medical staffs of the advisory and diagnostic health care centers under study was carried out based on results of five factors of working conditions studied earlier: intensity and severity of the working process, biological factor, microclimate parameters in warm and cold seasons (Table 2).

Load elements	Working conditions class	Gradation	
		Qualitative	Quantitative,score
Tension of the work process:			
Intellectual loads			
Content of the work	3.3	high	4
Signals perception	3.2	medium	3
Complexity of the task	3.2	medium	3
Performed work character	2	very low	1
Sensory loads			
Duration of attention concentration	3.2	medium	3
Signal density	1	no	0
Number of production objects	2	very low	1
Visual analyzer load	3.2	medium	3
Audial load	2	very low	1
Vocal load	2	very low	1
Emotional loads			
Responsibility level, the significance of the error	3.2	medium	3
Risk to own life	3.2	medium	3
Risk to the safety of others	3.2	medium	3
Load monotony			
Number of elements (movements)	3.2	medium	3
Duration, s	1	no	0
Time of active operations, %	1	no	0
Monotony of the production atmosphere	1	no	0
Operating mode			
Actual working hours	1	no	0
Shift work	1	no	0
Presence and duration of scheduled breaks	1	no	0
General assessment of the intensity of the work process	3.3	high	4
Hardness of the work process:			

physical dynamic load			
At regional load, when moving a load at a distance of up to 1 m	1	no	0
In general loading (involving the arm, trunk, and leg muscles)	1	no	0
Weight of manually lifted and moved cargo, kg			
Lifting and moving (single) weights when alternating with other work (up to 2 times per hour)	1	no	0
Lifting and moving (one-time) heavyweights continuously during a work shift	2	very low	1
Total weight of loads	1	no	0
Stereotypical working movements, number per shift			
In local loading (involving hand and finger muscles)	2	very low	1
At regional load	2	very low	1
Static load			
Static load per shift when holding a load, applying force, kg/s with two hands	1	no	0
Working pose			
Working pose	3.2	medium	3
Body bends, number per shift			
Body bends	3.1	low	2
Space movement, caused by the technological process during the shift, km			
Horizontal	3.1	low	2
General assessment of the severity of the work process	3.2	medium	3
Biological factor			
Total microbial count - 850 CFU in 1 m^3	3.3	high	4
Microclimate parameters during the warm period of the year			
Air temperature - 31.7±0.2 ^oC			
Relative humidity - 27.4±0.2%	3.1.	low	2
Airspeed - up to 0.5 m/s			
Microclimate parameters in the cold period of the year			
Air temperature -17.1±0.3 ^oC			
Relative humidity - 46.05±0.9%	3.1.	low	2
Airspeed - up to 0.2 m/s			

Table 2. Risk Probability Matrix with the Account of Working Conditions Classes for Medical Workers.

Note, CFU - colony-forming unit

A detailed analysis of the load elements of the tension of the work process allows us to conclude

that the highest probability of health risk development for medical workers in the advisory and diagnostic health care centers are intellectual, sensory, and emotional loads. Considering the elements of workloads, it was established that in the case of intellectual workloads, the most significant probability of risk development is formed by work content factor (class of working conditions - 3.3; high-risk probability; quantitative assessment - 4 scores), then by signals perception of (3.2; medium risk probability; 3 scores) and complexity of the task (3.2; medium risk probability; 3 scores).

In the structure of sensory loads, duration of attention concentration and visual analyzer load was the most significant quantitative probabilities of risk (3.2; medium risk probability; 3 scores).

Emotional loads accounted for the highest probability of risk based on responsibility, the risk to own life, and the safety of others (3.2; medium risk probability, 3). Therefore, when summarizing the final score for the workload tension indicators, the highest risk probability score was considered. In this regard, the definitive identification of risk probability was four scores.

The next psycho-physiological factor of working conditions was the hardness of the work process: physical dynamic load, the weight of manual lifting and moving cargo, stereotypical working movements, and static load, which were rated at one score, i.e., no probability of risk (grade 1) or very low probability risk (grade 2). The following three elements of the work process hardness made a significant contribution to the substantial probability of risk: working pose (3.2; medium risk probability; 3 scores), number of body bends per shift (3.1; low-risk probability; 2 scores), and space movement, caused by the technological process during the shift in kilometers (3.1; low-risk probability; 2 scores). The final identification of the risk probability by the hardness of the work process was set at three scores. The corresponding qualitative assessment equivalent allowed us to conclude that there was a possible risk to medical staffs' health.

Detecting microorganisms in the air of the advisory and diagnostic health care centers (rooms of narrow specialists, functional diagnostics room, procedure rooms, laboratories, etc.) was paid particular attention. During the laboratory analysis of bacteriological air pollution in the main premises, the value of total microbial count was studied in samples taken at the beginning, in the middle, and at the end of the working day. At the beginning and in the middle working day, the total microbial count values were within the hygienic standards established in SanPiN №0342-17 (from 200 to 750 microbes in 1 m3) ranged from 240 to 480 in 1 m3 of the air. However, the total microbial count in 12.3% of air samples was higher than hygienic norms and amounted to 850 CFU in 1 m3 by the end of the working day in the main premises of the advisory and diagnostic health care centers.

The final quantitative assessment of risk probability to the medical staffs' health and the served population by biological factor was set at the level of 4 scores. In contrast, a corresponding qualitative assessment indicated a high-risk probability occurrence.

In quantitative terms, identification of risk probability to the medical staff's health and the served population, according to parameters of the microclimate during warm and cold seasons, was estimated at three scores, while the equivalent qualitative assessment indicated the presence of a possible presence risk.

Further, in work, an attempt was made to assess possible risk consequences in the form of impairing medical staff's and patients' health of advisory and diagnostic health care centers (Table 3).

Working conditions		Risks consequences (impair)	
Class gradation	Class	Impair gradation	Score
Optimal	1	no	0
Permissible	2	no	0

Harmful	3.1	low	1
Harmful	3.2	medium	2
Harmful	3.3	significant	3
Harmful	3.4	high	4
Dangerous	4	very high	5

Table 3. Gradation of Possible Risks Consequences (impair to medical staffs' health) Taking into Account Classes of Working Conditions.

Assessment of possible risk consequences in the form of impair to medical staff and served patients' health was carried out according to the gradations established, taking into account classes of working conditions. For each working condition category, the level of possible impairment was determined in qualitative and quantitative terms. The quantitative estimation of risk made it possible to estimate the level of health risk to medical staff and served patients' health of the advisory and diagnostic health care centers in scores.

The estimation of possible risk consequences (impair to health), taking into account the classes of working conditions of the medical staffs of advisory and diagnostic health care centers, was carried out based on the results of five production factors: tension and hardness of the working process, biological factor, microclimate parameters in warm and cold seasons (Table 4).

Load elements	Working conditions class	Impair gradation	
		Qualitative	Qualitative
Tension of the work process:			
Intellectual loads			
Content of the work	3.3	significant	4
Signals perception	3.2	medium	3
Complexity of the task	3.2	medium	3
Performed work character	2	no impair	1
Sensory loads			
Duration of attention concentration	3.2	medium	3
Signal density	1	no impair	1
Number of production objects	2	no impair	1
Visual analyzer load	3.2	medium	3
Audial load	2	no impair	1
Vocal load	2	no impair	1
Emotional loads			
Responsibility level, the significance of the error	3.2	medium	3
Risk to own life	3.2	medium	3
Risk to the safety of others	3.2	medium	3
Load monotony			
Number of elements (movements)	3.2	medium	3
Duration, s	1	no impair	0
Time of active operations, %	1	no impair	0
Monotony of the production atmosphere	1	no impair	0
Operating mode			
Actual working hours	1	no impair	0
Shift work	1	no impair	0
Presence and duration of scheduled breaks	1	no impair	0

General assessment of the intensity of the work process	3.3	significant	4
Hardness of the work process:			
Physical dynamic load			
At regional load, when moving a load at a distance of up to 1 m	1	no impair	0
In general loading (involving the arm, trunk, and leg muscles)	1	no impair	0
Weight of manually lifted and moving cargo, kg			
Lifting and moving (single) weights when alternating with other work (up to 2 times per hour)	1	no impair	0
Lifting and moving (one-time) heavyweight continuously during a work shift	2	no impair	1
Total weight of loads	1	no impair	0
Stereotypical working movements, number per shift			
In local loading (involving hand and finger muscles)	2	no impair	1
At regional load	2	no impair	1
Static load			
Static load per shift when holding a load, applying force, kg/s with two hands	1	no impair	0
Working pose			
Working pose	3.2	medium	3
Body bends, number per shift			
Body bends	3.1	low	2
Space movement,			
Caused by the technological process during the shift, km			
Horizontal	3.1	low	2
General assessment of the severity of the work process	3.2	medium	3
Biological factor			
Total microbial count - 850 CFU in 1 m^3	3.3	significant	4
Microclimate parameters during the warm period of the year			
Air temperature - 31.7±0.2 ^oC			
Relative humidity - 27.4±0.2%	3.1.	low	2
Airspeed -s up to 0.5 m/s			
Microclimate parameters in the cold period of the year			
Air temperature -17.1±0.3 ^oC			
Relative humidity - 46.05±0.9%	3.1.	low	2
Airspeed - up to 0.2 m/s			

Table 4. Matrix of Possible Risk Consequences (impair to medical staffs' health) Taking into Account Classes of Working Conditions of Different Occupational Groups.

Note, CFU - colony-forming unit

Gradation of possible risk consequences (impair to health) was carried out, taking into account each element characterizing the class of working conditions. So, the 1st class of working conditions is optimal; work in such conditions has no possible consequences of risk/ impairment to health (0 scores). Permissible working conditions (2nd class) are characterized by working factors that are within hygienic norms. The worker’s body in permissible working conditions can recover during the rest period. Consequently, work in such conditions does not cause impairment to health, whereas in the case of insufficient rest, it may cause impairment, but to a very low degree. And in both cases, we assessed permissible working conditions as 0 scores.

At the same time, grade 3 is characterized by harmful working conditions, which exceed hygienic standards and have an adverse effect on the body. This, in its turn, contributes to the development of occupational pathology in a mild and moderate degree of severity and growth of chronic general somatic pathology, including an increase of morbidity level with temporary loss of ability to work. In this connection, working conditions established as grade 3 of 1, 2, 3, and 4 were harmful. We estimated them in qualitative and quantitative terms as small - 1 scores, medium - 2 scores, significant - 3 scores, and high - 4 scores. Whereas the 4th class of working conditions is dangerous and work in such conditions causes severe impairment to the health of medical staff, and in quantitative terms, we assessed it by five scores.

According to the summary data presented in Table 4, it can be stated that in the studied occupational groups of medical staff, the intellectual parameters of labor process tension are set within the range of second class to 3 class 3 degree of harmfulness.

Analysis of tension parameters of the work process allowed to establish that indices of intellectual loads of medical staff formed the classes of working conditions of workers of the advisory and diagnostic health care centers as 3.2 and 3.3, to determine the medium and high degree of possible impairment to health and estimate the possibility of impairment to health at 4 points.

Assessing the possibility of consequences (impairment to health) according to the hardness of the work process, it was determined that according to 4 factors of this indicator (physical dynamic work, weight of manually lifted and moving cargo, number of stereotypical working movements, and static load), working conditions of medical staff were optimal and permissible (1 and 2 classes).

According to indices of the working pose of medical staff, the number of body bends and movements in space during the work shift, working conditions were assessed as harmful - 3.1 and 3.2. Furthermore, assessment of the hardness of the work process established the possibility of medium degree impair, estimated in quantitative terms - 3 points. Working conditions in the advisory and diagnostic health care centers by parameters of biological factor are characterized by 3rd class of 3rd degree of harmfulness, which determines the possibility of a high degree of impair to the health of medical staff with four scores. Parameters of microclimate, regardless of the year, formed working conditions related to the 3rd class of the 1st degree of hazard, determining the possibility of a medium level of impair to the health of medical staff, and was evaluated at 3 points. After determining the probabilities of risk development and their possible consequences (impair to health) relative to each factor of the working environment, it is necessary to conduct a comparative analysis of the conditions of risk development, which consists in multiplying the points scored on the probability of risks and possible consequences (impair to health). As a result, in quantitative terms (in scores), we calculated the value of the level of risks on two criteria: 1 criterion - risk probability (none, low, medium, high, very high); 2 criterion - possible consequences /health impairment (low, medium, significant, high, very high), and the derivation of the scores allowed us to determine the risk level (small - green, medium - yellow, high - red) using the following matrix (Table 5).

Risk probability			Risk level, score		
Very high	5	10	15	20	25
High	4	8	12	16	20
Medium	3	6	9	12	15
Low	2	4	6	8	10
None	1	2	3	4	5
Impair degree to medical staff health	low	medium	significant	high	very high

Table 5. Risk Assessment Matrix for the Health Care Facilities Activities.

The results of the first two stages of risk assessment of the main occupational factors, such as labor tension, labor hardness, biological and microclimatic factors, are included in the risk assessment map of the advisory and diagnostic health care centers activities (Table 6).

Risk factors	Working conditions class	Grade, score		Risk level*, score (P × Y)
		Probability (P)		
Tension of the work process	3.3	4	4	16
Hardness of the work process	3.2	3	3	9
Biological factor	3.3	4	4	16
Parameters of microclimate in warm period of the year	3.1	3	2	6
Parameters of microclimate in cold period of the year	3.1	3	2	6

Table 6. Risk Assessment Map of the Advisory and Diagnostic Health Care Centers Activity Concerning Classes of Working Conditions for Medical Staff.

Note, * - 1-6 scores - low risk (green), 8-12 scores - medium risk (yellow), 15-25 scores - high risk (red)

The map of risk assessment of the advisory and diagnostic health care centers activities is compiled using comparing the results of quantitative estimates of risk probability and possible consequences in the form of impairment to medical staff health.

According to the risk assessment map, we can state that the working conditions of medical staff of the advisory and diagnostic health care centers by the tension of the work process and the biological factor in quantitative terms are estimated at 16 points and are characterized by a high level of risk (red). The influence of labor process hardness parameters on risk formation was estimated at 9 points, which indicates a medium-level risk (yellow). Considering microclimatic factors in both warm and cold periods of the year, working conditions have a risk of 6 scores, indicating a low level of risk (green).

The developed methodology of risk-oriented monitoring of health care facilities on the example of the advisory and diagnostic health care centers can transition from total sanitary-hygienic control to differentiated control by planning inspections taking into account the health risk assessment results of medical staff and served population.

In conclusion, intellectual, sensory and emotional loads (working conditions class 3.2, 3.3) as well as the biological factor (3.4) with a final identification equal to 16 points, which corresponds to a high risk level (red); identification of the risk probability and health impairment by the hardness of the work process (3.2) is set at 9 scores - medium risk (yellow), and by microclimate parameters, regardless of the season (3.1), corresponds to 6 scores - low risk level (green).

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