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Review

## KEY ASPECTS OF OCCUPATIONAL RISKS FOR HEALTHCARE WORKERS

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*At present, the greatest challenge associated with risks in healthcare is the lack of research on occupational diseases associated with healthcare workers' activities. Despite all achievements of the modern medicine and use of high-tech equipment, occupational health risks remain high in healthcare organizations. Few available literature sources assume that the level of actual occupational morbidity among healthcare workers is considerably higher than the official figures. This does not allow us to fully assess its prevalence. No unified approaches to investigating morbidity among healthcare workers have been developed yet. Analysis of available literature sources has revealed that most studies with their focus on peculiarities of working conditions and health of healthcare workers as well as associated risk factors are rather fragmentary and do not fully encompass all relevant aspects. At present, there is no unified organizational system for occupational safety that includes, among other things, scientific study of the issue. It is advisable to create a concept of occupational health risks in order to provide effective substantiation for selecting managerial decisions on regulation of effects produced by risk factors on personnel employed by healthcare organizations. The methodology for occupational health risk analysis is eligible for becoming an instrument that can ensure an effective policy aimed at protecting and promoting health of healthcare workers.*

**Keywords:** healthcare workers, risks, occupational infections, occupational morbidity, working conditions.

Occupational activities of healthcare workers and their health protection upon harmful occupational exposures are among relevant challenges the contemporary healthcare has to tackle. As far back as the beginning of 20<sup>th</sup> century, Vladimir Bekhterev, an outstanding Russian scientist and doctor, wrote an article entitled On Status of Doctors in Russia and on Investigation of Doctor's Work. He pointed out in this work that "protection of healthcare workers' (HCWs) health" is an important issue "just like protection of mother and child is important for securing health of future generations"<sup>1</sup>.

As can be learned from publications, statistical data collected in 20ties last century re-

ported relatively high morbidity among doctors across the globe. Mortality among doctors was shown to be in general nine times as high as average population mortality<sup>1</sup>. Basic causes of mortality for doctors included deaths during military operations, due to camp fever and other communicable diseases. A decline in mortality caused by communicable diseases in the middle of the 20<sup>th</sup> century created a conviction that the world had overcome the challenge [1]. However, according to data available in foreign publications, at present not one country has a system for complete tracking of fatal occupationally acquired infectious diseases. Various estimates give figures of 9–42 healthcare workers per

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<sup>1</sup> Nikiforov A.C. Bekhterev. Moscow, Molodaya Gvardiya Publ., 1986. Available at: <https://www.rulit.me/books/behterev-read-227360-123.html> (March 05, 2024) (in Russian).

one million who annually die from occupationally acquired infections worldwide. Still, the occupational death rate for healthcare workers is unknown [2].

As far back as in 1923, Russian scientists (E.M. Kagan, M.Ya. Lukomskiy, N.A. Savelev and others) spoke about the necessity to create institutes for occupational hygiene and clinics to treat occupational diseases in the country. At the same time, the Sub-Department for Occupational Hygiene of USSR Narkomtrud, together with the Sanitary-Epidemiological Department of RSFSR Narkomzdrav, prepared draft orders on mandatory registration of occupational poisonings and diseases. The Moscow Sanitary Organization was the first to introduce mandatory registration of occupational poisonings and diseases. It submitted a draft mandatory order concerning the issue to Moscow Council<sup>2</sup>. References available in literature give evidence that concrete data on occupational diseases detected in healthcare workers were not ever published in open access but remained closed and stamped 'For Official Use Only' over the whole USSR period (up to 1985) [3, 4].

According to reports published by the World Health Organization (WHO), healthcare workers have to face occupational health risks. Among them, the most frequent include exposure to harmful chemicals; occupationally acquired infections; radiation exposure; psychosocial risk factors and mental health; unsafe patient care; violence and harassment<sup>3</sup>. Russian studies report that healthcare as an occupation involves elevated risks of diseases of various geneses. Healthcare workers may be exposed to harmful and hazardous physical, chemical and biological factors as well as a wide range of psychophysiological factors in their occupational activity [5]. High levels of occupational exposure at workplaces induce occupational and work-related diseases as well as aggravate other health issues [6].

Data obtained by Special Assessment of Working Conditions were presented by the Department for Working Conditions and Labor Protection of the Ministry of Labor during the 15<sup>th</sup> Russian National Congress with International Participation "Occupation and Health" in 2019 in Samara. According to them, harmful working conditions account for 56.7 % in healthcare and this puts this sphere on the second rank place among seven basic economic activities where it surrenders the first place to mining operations [7, 8].

Healthcare as an occupation involves high health risks as per frequency and severity of associated diseases. Several Russian experts report in their works that only 2 % of all healthcare workers in Russia are considered absolutely healthy [9, 10]. Seventy-six percent of healthcare workers in the country have chronic diseases and only 40 % of them have regular medical check-ups. Chronic polyetiological diseases prevail among healthcare workers; they are induced by exposure to a set of factors, including lifestyle and living conditions, against constantly growing occupational requirements and workloads [9, 10]. On the one hand, several specific factors associated with occupational stress affect healthcare workers; on the other hand, healthcare workers are exposed to the same risk factors of chronic non-communicable diseases as population in general [11]. The major share of occupational diseases occurs in nurses [12, 13], who have these diseases diagnosed upon applying for medical aid and not during regular check-ups. In Russia, up to 64 % of all occupational diseases detected in healthcare workers were registered in nurses [12, 13].

The Expert Council on Healthcare of the Federation Council Committee on Social Policy points out that a very small share, not higher than 10 %, of actual occupational pathologies is detected in healthcare workers.

<sup>2</sup> Rozanov L.S. 50 let organizatsii v SSSR raboty po izucheniyu i profilaktike professional'nykh boleznei [The 50-year anniversary of organizing work on investigation and prevention of occupational diseases in the USSR]. *Gigiena i sanitariya*, 1975, no. 8, pp. 41–43 (in Russian).

<sup>3</sup> Occupational hazards in the health sector. *WHO*. Available at: <https://www.who.int/tools/occupational-hazards-in-health-sector> (March 19, 2024).

But these preliminary estimates require further profound scientific substantiation [4, 10]. At present, there is certain lack in studies with their focus on work-related diseases. Few available literature sources assume that the level of actual occupational morbidity among healthcare workers is considerably higher than the official figures and this does not allow us to fully assess its prevalence<sup>4</sup> [4, 8, 14–16].

No unified approaches to investigating morbidity among healthcare workers have been developed yet. Occupational pathology among healthcare workers can be underestimated due to several reasons such as a long latent period from the moment of getting infected; frequent change of a workplace; registration defects; etc. The reasons why reliable data on occupational morbidity among healthcare workers are unavailable can include the following: healthcare workers tend to resort to self-treatment (according to Russian experts, this is typical for approximately 80 % of healthcare workers); rather low levels of application (within 60–80 %) for medical aid; colleagues tend to provide healthcare at workplace in case of need; some healthcare workers do not wish to disclose their diseases; prenosological diagnostics methodological algorithms lack efficiency; socioeconomic reasons [8, 17, 18].

G.G. Badamshina pointed out that application for qualified medical aid among healthcare workers was described with the following indicators:  $26.0 \pm 3.3$  % of the respondents never went to narrow specialists and treated themselves;  $58.0 \pm 3.8$  % of the respondents applied for specialized medical aid only in case of a severe disease<sup>5</sup>. According to the survey [19] among emergency personnel, 13.2 % of the respondents considered themselves healthy (health group I) and 35.1 % practically healthy (health group II); 39.2 % thought they fell sick rarely (health group III) and 12 % complained of often falling sick

(health group IV). Healthcare workers think that their health deteriorates due to personal factors, on the one hand, including neglect of it (35 % of the respondents) and chronic diseases (25.3 %); on the other hand, due to external factors such as occupational specificity (34 % of the respondents), ecology (23 %), and poor working conditions (22,2 %).

Despite all achievements of the modern medicine, use of high-tech equipment, and reduction in manual labor occupational health risks remain high in healthcare organizations. To implement the Decision made by the Rospotrebnadzor Board ‘Relevant Issues Concerning Surveillance over HAIs and Improvement of Prevention Activities’ and to fulfill the Order dated January 26, 2018 No. 37, the Reference-Center (RC) for Monitoring over HAIs of the Rospotrebnadzor’s Central Scientific Research Institute of Epidemiology developed new statistical report forms in addition to the data provided in Section 3 Hospital Acquired Infections of the Federal Statistical Observation Form ((FSOF) No. 2. These new forms should be used to perform in-depth epidemiological analysis of HAI-associated morbidity considering relevant risk factors; they were sent out to all regional offices of Rospotrebnadzor in all RF regions. Some supplements were also made into Section 3 of the Form No. 2 Data on Infectious and Parasitic Diseases; since 2020, the Section should include data on occupationally induced HAI cases in healthcare workers.

According to Rospotrebnadzor data, occupational morbidity went down by 44.13 % in the Russian Federation in 2022 against 2013 (2022: 1.00 per 10 thousand workers; 2013: 1.79 per 10 thousand workers). Diseases associated with the new coronavirus infection took the first rank place among basic occupational nosologies upon exposure to biological factors accounting for 91.44 %; they were followed by tuberculosis (6.14 %) and brucellosis (0.97 %). In 2022, there was one detected case of occu-

<sup>4</sup> Kosarev V.V., Babanov S.A. Professional'nye bolezni [Occupational diseases]: manual. Moscow, GEOTAR-Media, 2010, 368 p. (in Russian).

<sup>5</sup> Badamshina G.G. Biologicheskii risk razvitiya narushenii zdorov'ya u meditsinskikh rabotnikov [Biological risk of health issues in healthcare workers]: dissertation ... for the Doctor of Medical Sciences degree. Kazan, 2022 (in Russian).

pational disease due to HIV infection (0.16 %)⁶. Healthcare workers are exposed to occupational risks of multiple infections able to cause severe disease and even accidental death. In 2022, 41,254 occupationally induced HAI cases were established in healthcare workers, which was by 34 % lower than in 2022 (63,225 cases) [20].

Communicable diseases, as reported in literature, occupy the leading place in occupational pathology of healthcare workers (75.0–83.8 %); the second rank place belongs to allergic diseases (contact dermatitis, bronchial asthma, etc.); the third one, poisonings and diseases of the musculoskeletal system [4, 8]. Early diagnostics is still significant in prevention of occupational diseases among healthcare workers [20]. But it should be noted that, as a rule, only diseases that cannot be hidden are diagnosed in healthcare workers; such diseases typically develop into severe states with persistent loss of work ability. Primarily, they include such infections as viral hepatitis and tuberculosis [4, 8].

Tuberculosis remains a very serious occupational health risk for healthcare workers [21]. Studies conducted by several authors in various countries across the globe report a high risk of tuberculosis infection among patients and healthcare workers [21–30]. This leads to higher morbidity caused by this infection among healthcare workers than among population in general [24, 27, 30]. Average annual incidence of tuberculosis associated with work in healthcare equaled 5.8 % (within 0–11 % range) in low-income countries and 1.1 % (within 0.2–12 % range) in high-income ones [24]. Active tuberculosis rates were persistently higher among healthcare workers than in population in general in all countries. The risk seemed especially high upon elevated exposure combined with insufficient infection control [24].

Some studies report the risk of tuberculosis to be 7.5–60 times higher among healthcare workers employed at specialized anti-tuberculosis hospitals than population in general⁷ [31]. It depends on how long and how often a healthcare worker has to be in an environment that contains mycobacterium tuberculosis [32–35]. Tuberculosis in healthcare workers has some peculiarities including infection by multi-resistant mycobacteria, proneness to destructive tuberculosis, and frequent complications; all this may lead to permanent disability and death as well as recurrent infection [3, 4, 30, 31, 36]. A retrospective cohort study among healthcare workers from the Beijing Chest Hospital aimed to determine risk factors able to cause hospital acquired tuberculosis; use of data collected over the last 13 years established that artificial ventilation systems did not provide effective anti-tuberculosis protection in case they were not properly maintained, quite the opposite from natural ventilation⁸. The authors point out that their findings are consistent with other reports on tuberculosis infection in healthcare organizations where ventilation systems were either broken, thus requiring constant maintenance, or just absent [37].

About 26 various viruses can cause occupational infection. Among them, only three (HBV, HCV, and HIV) cause most occupationally acquired blood infections. Global prevalence of acute viral hepatitis B (VHB) was shown to reach 5.3 % among healthcare workers [38]. According to some data, levels of hepatitis B infection can reach 32.6 % among healthcare workers in Russia [39].

Multiple studies report that healthcare workers are exposed to an elevated risk of getting infected with bloodborne pathogens during occupational contacts with blood and body fluids [40–43]. This happens when a patient's

⁶ O sostoyanii sanitarno-epidemiologicheskogo blagopoluchiya naseleniya v Rossiiskoi Federatsii v 2022 godu [On sanitary-epidemiological welfare of the population in the Russian Federation in 2022]: State Report. Moscow, Federal Service for Surveillance over Consumer Rights Protection and Human Wellbeing, 2023, 368 p. (in Russian).

⁷ Satsuk A.V. Osobennosti epidemiologii i profilaktiki tuberkuleza sredi rabotnikov meditsinskikh uchrezhdenii [Peculiarities of tuberculosis epidemiology and prevention among healthcare workers]: dissertation ... for the Candidate of Medical Sciences degree. Moscow, 2010, 23 p. (in Russian).

⁸ WHO Policy on fighting tuberculosis in healthcare facilities, crowded places and households. Geneva, WHO, 2009.

infected body fluid gets on a healthcare worker's mucosa as well as by accidental needlestick injuries or injuries inflicted by a contaminated sharp medical device. According to the US Centers for Disease Control, healthcare workers in hospitals in the USA annually suffer more than 385,000 needlestick injuries. Needlestick injuries and sharps injuries pose a serious occupational threat for healthcare workers due to seroconversion [44]. The WHO data give evidence that the proportion of HCV, HBV and HIV due to needlestick injuries equals 39, 37 and 4.4 % accordingly [45]. Some foreign studies report findings concerning remote effects of HBV and HCV infection in healthcare workers. Approximately 100 healthcare workers are established to die annually due to severe remote effects such as cirrhosis or primary liver cancer. One healthcare worker dies of HBV every day [46, 47].

Needlestick injuries, being a serious occupational threat for healthcare workers, are very frequently and quite wrongfully considered a very low risk; the situation is aggravated further by underreporting [48]. G.A. Katsevman and others conducted a cross survey among medical students, students working as nurses and hospital residents. Its focus was on investigating rates of needlestick injuries, reasons for underreporting, and what effect could be produced on those prone to such injuries by open declarations about patients being 'high-risk'. The survey established that major reasons for non-reporting included the injury being perceived as 'trivial' (22 %) and patient being 'low-risk' (18 %). A majority stated pre-operative 'high-risk' announcements should be required (91%), and would promote 'culture of safety' (82 %), reporting of injuries (85 %), and increased concentration during procedures (70 %). [48]. Russian authors point out that a Russian nurse responsible for procedures on average suffers one needlestick injury per 90 injections [9]. And as healthcare workers

admit themselves, less than a half of such injuries are registered in emergency logs [49, 50].

Recent experiences of emerging infections, such as severe acute respiratory syndrome (SARS), avian influenza (H<sub>5</sub>N<sub>1</sub>) and swine influenza (H<sub>1</sub>N<sub>1</sub>), have highlighted the risks of serious pulmonary infections from occupational exposures and disclosed healthcare workers to be specifically susceptible to them. Atypical pneumonia was diagnosed in 8096 people across the globe and healthcare workers accounted for 21 % of them [51, 52]. SARS was known to be spreading intensely among healthcare workers in various conditions. During outbreaks in Hong Cong and Toronto, healthcare workers accounted for 62 % [53] and 51 % [54] of infected patients. The first influenza A (H<sub>5</sub>N<sub>1</sub>) outbreak occurred in Hong Cong in 1997 and prevalence of antibodies to H<sub>5</sub>N<sub>1</sub> was five times as high in exposed healthcare workers than in those who did not have any contacts with avian influenza patients, that is, 3.7 % (8 / 217) against 0.7 % (2 / 309)<sup>9</sup>. Over the last two decades, experts have mastered the knowledge how various viral infections emerge and what effective strategies can be used to overcome them: severe acute respiratory syndrome (SARS-nCoV, 2002), Middle-East respiratory syndrome (MERS-CoV, 2015), a large Ebola disease outbreak in West Africa (2014–2015), a Zika fever outbreak (2016) and others [55].

Before 2020, tuberculosis and viral hepatitis were considered the most common occupational diseases caused by biological exposure. Then, starting from 2020, the world had to face another occupational communicable disease, namely, the new coronavirus infection that was deemed occupational for healthcare workers [56]. COVID-19 was identified as 'the first new occupational disease described in this decade'. According to the Society of Occupational Medicine [57], activity of infection and disease risk factors determines a considerable share of diseases caused by biologi-

<sup>9</sup> Novaya koronavirusnaya infektsiya COVID-19: professional'nye aspekty sokhraneniya zdorov'ya i bezopasnosti meditsinskikh rabotnikov [New coronavirus infection COVID-19: occupational aspects of health protection and safety provided for healthcare workers]: methodical guidelines. In: I.V. Bukhtiyarov, Yu.Yu. Gorblyanskii eds. Moscow, AMT, FSBSU "NII MT" Publ., 2021, 132 p. (in Russian).

cal exposures in healthcare workers [58]. Healthcare workers accounted for more than 10 % of patients with confirmed new coronavirus infection COVID-19 in various countries at the moment the study [59] was being conducted.

Often severe disease course and unfavorable COVID-19 outcomes in doctors of various specialties were evidence of a high infection risk. Men prevailed among deceased (up to 90 %), people aged older than 57 years (75 %), predominantly (52 %) common practitioners and doctors working in emergency units as well as anesthesiologists, dentists, ENT doctors and ophthalmologists. The greatest numbers of COVID-19 cases among healthcare workers were detected in Italy (44 %), Iran (15 %), the Philippines (8 %), Indonesia (6 %) and China (6 %), Spain (4 %), USA (4 %), and Great Britain (4 %) [59, 60]. Several risk factors caused severe COVID-19 and deaths among healthcare workers including older age and concomitant chronic diseases (essential hypertension, diabetes mellitus, cardiovascular diseases, chronic lung diseases, and weak immunity). At present, there are no reliable data on possible differences in levels of risk associated with concomitant diseases in different population groups or under different conditions.

A systemic review of 11 articles (published in China, Singapore, Italy and the USA) established five basic factors of hospital-acquired COVID-19 in healthcare workers: long contacts with infected patients; insufficient provision with personal protective equipment (or its absence); overstrain at workplace; low-quality infection control (failure to observe personal hygiene); concomitant diseases. Infection among healthcare workers was associated with overcrowded units, long contacts with COVID-19 patients, absence of any rooms for isolation, and high levels of viral contamination in a working environment. Thus, 55 % of 9292 COVID-19

cases among healthcare workers were shown to be caused by exposures in healthcare organizations.

Catastrophic conditions created by epidemics and pandemics, have challenged the humankind throughout its history calling for innovations and giving opportunities to such disciplines as anesthesiology and resuscitation to achieve considerable success in their development [61]. Anesthesiologists and doctors in resuscitation found themselves at the front line in this pandemic battle. 'Pandemic human resources management' in intensive care, anesthesiology and emergency units was introduced to deal with personnel who worked in intensive care units and had to treat several patients due to severe lack of human resources. This created a solid ground for 'pandemic burnout' among healthcare workers [62].

Scientific grounds of occupational risk assessment are known to be based on concepts developed by the World Health Organization (WHO), International Labor Organization (ILO), as well as on International systems of standards developed by the International Organization for Standardization (ISO), and EU Directives<sup>10</sup>. In 2011, the Clause 209 of the RF Labor Code was added with definitions of such terms as 'occupational risk' (OR) and 'occupational risk management' (ORM). OR is likelihood of health harm upon exposure to harmful and (or) hazardous occupational factors for workers who fulfill their responsibilities in accordance with their labor contracts. Several theories on risk assessment and management have appeared in recent years. They are developing rapidly and are applied in industries and objects but they have never been applied to healthcare organizations so far.

The occupational risk methodology has been developed in Russian occupational medicine. It allows predicting likelihood of diseases caused by basic occupational factors at a

<sup>10</sup> Bektasova M.V. Nauchnoe obosnovanie sistemy profilakticheskikh meropriyatii po snizheniyu professional'nykh riskov zdorov'yu meditsinskikh rabotnikov [Scientific grounds for the system of preventive activities aimed at reducing occupational risks for healthcare workers]: dissertation ... for the Doctor of Medical Sciences degree. Vladivostok, 2020 (in Russian).

workplace<sup>11</sup>; estimating how strong a relation is between work and diseases detected during regular medical check-ups. Studies have been published on how to implement intellectual systems for risk assessment in occupational healthcare [63] in order to develop the system for occupational risk management based on evidence<sup>12</sup> involving prognostic mechanisms, including those based on up-to-date bioinformatics technologies<sup>13</sup>. Finding solutions to these tasks has predetermined a shift in the paradigm towards the methodology for occupational risk assessment in occupational medicine [64]. Still, we have not found any data in the examined literature sources about development and implementation of up-to-date research technologies for assessing exposure and predicting likelihood of negative effects to

manage occupational health risks for such a numerous occupational group as healthcare workers<sup>10, 11</sup>.

Therefore, literature analysis has established that studies with their focus on investigating specific working conditions and health of healthcare workers as well as associated risk factors are rather fragmentary and do not sufficiently cover all necessary aspects. Today, it is necessary to develop a solid scientific base and to create a unified organizational system for providing occupational safety for healthcare workers.

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<sup>11</sup> Prognozirovanie vozdeistviya vrednykh faktorov uslovii truda, i otsenka professional'nogo riska dlya zdorov'ya rabotnikov: Metodicheskie rekomendatsii, utv. Nauchnym sovetom № 45 «Mediko-ekologicheskie problemy zdorov'ya rabotayushchikh» RAMN 9 noyabrya 2010 g. [Prediction of effects produced by harmful working conditions and assessment of occupational health risks for workers: Methodical guidelines, approved by the Scientific Council No. 45 Medical and Ecological Issues of Workers' Health of the RAMS on November 09, 2010]. Moscow, SRI MT RAMS, 2010 (in Russian).

<sup>12</sup> Vlasov V.V. Vvedenie v dokazatel'nyu meditsinu [Introduction to evidence-based medicine]. Moscow, Media Sfera Publ., 2001, 392 p. (in Russian).

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