Occupational disease monitoring by the Korean Occupational Disease Surveillance Center: a narrative review

Running title: Occupational disease surveillance in Korea

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Abstract

This review examines the challenges associated with occupational disease surveillance in Korea, particularly emphasizing the limitations of current data sources such as the Industrial Accident Compensation Insurance (IACI) statistics and special health examinations. The IACI system undercounts cases due to its emphasis on severe diseases and restrictions on approvals. Special health examinations, although they cover a broad workforce, are constrained by their annual scheduling, which leads to missed acute illnesses and subclinical conditions. The paper also explores the history of

occupational disease surveillance in Korea, highlighting the fragmented and disease-specific approach of earlier systems. The authors introduce the newly established Korea Occupational Disease Surveillance Center (KODSC), a comprehensive nationwide system designed to gather, analyze, and interpret data on occupational diseases through a network of regional centers. By incorporating hospital-based surveillance and focusing on acute poisonings and other sentinel events, the KODSC aims to overcome the limitations of previous systems and promote collaboration with various agencies. Although it is still in the early stages of implementation, the KODSC demonstrates potential for improving data accuracy and contributing valuable insights for public health policy.

Keywords: Data accuracy; Health policy; Occupational diseases; Republic of Korea; Workforce

Introduction

Background

Korea began its industrialization in the 1960s, leading to the construction of numerous factories throughout the 1970s and 1980s. As a result, coal mining expanded significantly to meet the energy demands of the manufacturing industry and to provide a source of home heating. The manufacturing processes involved the use of various chemicals. This shift towards a manufacturing-based economy has been associated with several occupational diseases, including carbon disulfide and heavy metal poisoning [1]. In recent years, Korea has achieved global competitiveness in several sectors, including mobile phones, semiconductors, automobiles, chemicals, and steel manufacturing. Additionally, Korean cultural content such as music, gaming, and webtoons has become a vital industry, playing a pivotal role in the national economy. Despite these advancements, the manufacturing sector remains the largest in terms of gross domestic product (GDP), followed by sales and retail [2].

Despite Korea's impressive economic growth, occupational injuries continue to pose a significant problem. By 2022, the rate of fatal occupational injuries per 100,000 workers is projected to be 4.33. This figure is substantially higher than Japan's rate of 1.54 and Germany's 0.84, placing Korea among the higher ranks of International Labour Organisation (ILO) member countries [3]. The ILO reports that approximately 2.3 million women and men globally die each year from work-related accidents or diseases, which equates to over 6000 deaths daily. Furthermore, around 340 million occupational accidents and 160 million cases of work-related illnesses are recorded annually worldwide [4].

Recent Global Burden of Disease research has concentrated on the impact of occupational factors; however, this impact is relatively minor in high-income countries. Determining the burden of occupational diseases presents significant challenges, particularly due to the incubation period of chronic diseases, high turnover rates in flexible labor markets, and the necessity for reliable information to confirm exposure [5]. Identifying cases linked to occupational factors is crucial for compiling these data, which are vital for public health. Routine surveillance systems, such as the Health and Occupation

Research (THOR) network, play a key role in providing important data sources [6].

Objectives

This review examines the importance of establishing a routine surveillance scheme as a foundational framework for comprehending the burden of occupational diseases. It also describes the occupational disease surveillance system that was recently implemented in Korea.

Ethics statement

As this study is a literature review, it did not require institutional review board approval or individual consent.

Occupational disease and surveillance

The term "surveillance" originates from a French word meaning "to watch over" [7]. It is defined as the continuous, systematic collection, analysis, and interpretation of health-related data that are crucial for the planning, implementation, and evaluation of public health practices. This process is tightly linked with the prompt dissemination of these data to individuals responsible for prevention and control measures [8]. The goal of surveillance is to supply information that public health personnel, government leaders, and the community can use to inform public health policies and programs [9,10].

It is important to utilize multiple data sources to accurately gauge the prevalence of occupational diseases. In Korea, the Industrial Accident Compensation Insurance (IACI) statistics serve as one such source for tracking the number of occupational diseases. However, this system only allows claims for severe diseases, and approximately two-thirds of these claims are approved. Consequently, the IACI statistics may not fully represent the actual incidence of occupational diseases. Additionally, the disparity between the ratios of fatal to non-fatal cases in occupational injuries and illnesses indicates that some data might be missing [11].

In 2022, statistics approved by the IACI indicated that 23,134 individuals were recognized as having occupational or work-related diseases. Although this figure might initially appear substantial, a deeper analysis highlights several concerning issues. More than half of these cases were attributed to musculoskeletal disorders, deaths from cardio- or cerebrovascular diseases due to overwork, and mental illnesses. Noise-induced hearing loss was responsible for 5,376 cases, while pneumoconiosis accounted for 1,679 cases [12]. Given the presence of 600,000 manufacturing workplaces and 3.4 million workers in Korea, the reported 553 cases related to exposure to hazardous chemicals seem implausibly low. This significant discrepancy points to a potential shortfall in the current system's ability to capture a comprehensive range of occupational diseases.

Another source of occupational disease surveillance is special health examinations. These are occupational health screening tests designed for the early detection of selected occupational diseases in workers. It is mandatory for employees exposed to 181 risk factors, including hazardous chemicals, gases, physical risk factors, and night work, to undergo these examinations. To date, almost 2.2 million workers have been examined under this system. However, due to the nature of medical examinations, which are typically conducted at one-year intervals based on exposure to specific physical and chemical hazards, they are useful in identifying chronic diseases in workers who have been employed for more than one year. Nonetheless, they have limitations in identifying subclinical conditions or diseases that may manifest acutely in the absence of a clinical examination [13]. Periodic health examinations cannot detect acute illnesses or subclinical conditions and require workers to have been employed at a workplace for more than a year. Consequently, short-term or day laborers who frequently change workplaces are not included in the statistics. This system also overlooks small-scale workplaces and foreign laborers. The most commonly observed conditions (95%) are pneumoconiosis and noise-induced hearing loss, with examinations typically conducted annually. This frequency makes it challenging to detect diseases that arise acutely. Indeed, an analysis of the rate of special health examinations in workplaces with five or more employees revealed that less than 5% of manufacturing workplaces had fewer than five employees, 20% of workplaces had between 5 and 49 employees, and

85% had 50 or more employees [14]. As a result, similar poisonings and deaths, such as those caused by methanol [15], mercury [16], fire extinguishing agent HCFC-123 [17], and dichloromethane [18], have continued to occur until recently.

There are inherent gaps in Korea's occupational disease surveillance system when it relies solely on compensation data from the IACI and special health examinations. The current statistics on occupational diseases are inadequate for understanding the full extent of this issue in South Korea. To adequately represent and include vulnerable groups, it is crucial to establish surveillance systems based on reporting and registration.

History of occupational disease surveillance

Awareness of occupational health issues has led to the development of various disease surveillance systems, which are centered around specific diseases, regions, and exposures. While these systems have achieved some of their intended outcomes during their operational periods, the need for a more integrated approach has become increasingly apparent. Among the most notable disease-focused surveillance systems are those targeting asthma and lung cancer. A comprehensive overview of the different surveillance systems implemented in Korea is detailed in Table 1. The Occupational Asthma Surveillance System, the longest-running system of its kind in Korea, has been instrumental in estimating the incidence of occupational asthma and identifying its major risk factors [19]. Similarly, the lung cancer surveillance system has been crucial in providing data on lung cancer cases, highlighting the potential for prevention through reduced exposure to hazards in the workplace [20].

Despite some achievements, funding for these surveillance systems was provided in a fragmented manner, primarily through research grants, which posed challenges in establishing a system capable of continuous operation. Furthermore, as researchers developed disease-specific, hazard-specific, and

regional surveillance systems, inconsistencies arose in their definitions, scopes, and priorities. Consequently, there is a growing need for a continuous, full-time, nationwide surveillance system. With advancements in big data science and technology, there is an increasing interest in developing a surveillance system that leverages regularly produced data, adhering to legal regulations concerning occupational health. Efforts are underway to create a carcinogen surveillance system utilizing national data, as well as a system that integrates various national datasets [21,22,23].

However, the aforementioned limitations inherent in the national data suggest that data-driven surveillance is not suitable for addressing urgent issues. Identifying sentinel health events is crucial for the prevention and treatment of occupational diseases [24]. This process also marks the initial step in recognizing emerging occupational diseases or health hazards, such as acute poisoning from newly developed industrial chemicals or unforeseen exposures. The acute poisoning event discussed earlier exemplifies this issue. Consequently, discussions are underway to establish a surveillance system specifically tailored to acute poisoning. This system aims to prevent and identify incidents caused by newly introduced industrial chemicals, beyond the previously mentioned cases of methanol poisoning, dichloromethane poisoning, or HCFC-123.

The Occupational Acute Poisoning Disease Regional Surveillance Pilot Project, which ran from 2016 to 2020, achieved significant outcomes, including the identification of a case of toxic encephalopathy caused by 1,2-dichloropropane. This pilot project utilized a mixed surveillance system that focused on region-specific diseases. The results underscored the importance of implementing a hospital-based surveillance system that involves direct interaction with patients to effectively detect acute poisoning and occupational diseases. In response to these findings, the government has decided to manage the surveillance system as a government-led initiative, transitioning away from the previous research-oriented approach. However, due to the challenges government agencies face in direct management, the system now operates through partnerships with the Department of Occupational and Environmental Medicine and other clinical departments in major general hospitals, where patients receive care.

New scheme for occupational disease surveillance

The Korea Occupational Disease Surveillance Center (KODSC) is a surveillance system designed to collect, analyze, and interpret cases of occupational disease. It was established in 2022, and by 2024, 10 regional centers were operational, in accordance with the regional Ministry of Employment and Labor (MOEL) offices.

The missions of KODSC are as follows:

- Collect suspected cases of occupational disease reported by clinicians
- Carry out data production and management
- Perform workplace inspections and walk-through surveys to detect occupational risk
- Provide medical consultations for occupational disease or injury cases of MOEL regional offices

Fig. 1 shows the overall organizational chart. A substantial component of this surveillance system is dedicated to gathering reports of occupational diseases, including acute poisoning, from key emergency medical facilities in the region. Although certain aspects of the current system may not be monitored, it is expected that individuals will seek medical care at a hospital when they feel unwell. The KODSC surveillance network system has been established across ten regional centers. These centers are typically university hospitals, which are the primary hospitals in their respective regions. They feature collaborations between the Department of Occupational and Environmental Medicine and the Regional Emergency Medical Center, serving both severe trauma patients and those with various other diseases.

The Department of Occupational and Environmental Medicine (OEM) at the university hospital, designated as the center, will work in collaboration with the MOEL regional office to establish a coordination system. This system will involve various hospitals within the region and will integrate

with the emergency medical system and other clinical departments of the hospital. The aim is to facilitate the reporting of various suspected cases of occupational diseases identified in the region. Each center compiles these reports and submits them to the MOEL, allowing for a national overview of the data. Data concerning monitored cases of occupational diseases are communicated to the Ministry of Employment and Labor and the Korea Occupational Safety and Health Agency. Some of these reported cases may undergo further testing for confirmation. If necessary, preventive measures may be developed in collaboration with the MOEL and the Korea Occupational Health and Safety Agency.

Fig. 2 illustrates the roles and responsibilities of the center, which is divided into three teams: the Investigation and Analysis Team (IAT), the Prevention and Support Team (PST), and the Corporate Relations Team (CRT). Each center includes occupational and environmental clinics that diagnose and treat patients with occupational diseases. The IAT manages the KODSC, which initially collects patient information when a suspected occupational disease is reported. This team also determines whether a risk investigation is necessary. If so, the IAT coordinates an on-site investigation at the workplace where the disease was reported. The primary role of the IAT is to assess the work-relatedness of the disease in patients with suspected occupational diseases and to manage data on these cases. Doctors and health professionals in emergency rooms or clinics may encounter patients suspected of having occupational diseases. In such instances, they can report these cases to the KODSC without a confirmatory test. They simply complete a prespecified form and submit it via a homepage, SMS, social network service, or health information system. Most reported cases are stored in the database after evaluation and clarification by the OEM doctors and health professionals at the KODSC.

In cases requiring urgent intervention, the KODSC collaborates with MOEL and KOSHA to support occupational disease investigations. This includes conducting workplace inspections and walk-through surveys to identify occupational hazards. PST supports the IAT in executing on-site workplace investigations. Working closely with KOSHA, the team visits sites where severe occupational diseases have been reported or are likely to occur, offering consultation and recommendations for improvements.

For instance, after an on-site investigation, the team may conduct sample analyses of suspect chemicals, such as cleaning agents, either independently or in cooperation with KOSHA. Following the investigation, in conjunction with KOSHA, the team provides details on the workplace environmental improvement support scheme. Additionally, if necessary, they offer information on workers' compensation procedures to patients with occupational diseases.

The CRT is responsible for maintaining and managing a network designed to collect reports of suspected occupational diseases. The team strives to ensure the network remains fully operational to handle incoming cases. It collaborates with the emergency department coordinator to confirm the medical histories of patients visiting the emergency department. Additionally, the CRT routinely visits partner hospitals and other relevant institutions within the region to gather data on suspected occupational disease cases, which are then forwarded to the investigation and analysis team. This process forms the foundation of the national occupational disease database. However, significant cases and outbreaks necessitate immediate action. Establishing a network through connections with local medical staff is crucial. Moreover, maintaining a strong relationship with the Ministry of Employment and Labor and KOSHA is essential. To achieve these goals, we consistently engage in various activities, including publishing newsletters and organizing workshops.

KODSC statistics

The case definitions for reporting included occupational diseases caused by physical, chemical, and biological factors, with the exception of cases involving evident trauma. There was a particular emphasis on reporting suspected cases of acute poisoning in relation to the Serious Accident Punishment Act (SAPA). Work-related musculoskeletal disorders, which represent the majority of workers' compensation claims, are not required to be reported. Additionally, cerebrovascular or cardiovascular disorders that have already been diagnosed and are known are also excluded from reporting. As a general rule, all occupational diseases must be reported, regardless of the patient's nationality or whether

they are enrolled in a worker's compensation insurance scheme.

Table 2 displays the number of suspected cases reported since the establishment of the KODSC in 2023. That year, a total of 4,341 suspected cases were reported nationwide, with 57 cases receiving assistance for investigations under the SAPA. About 30% of these cases were reported through outpatient services or admissions at hospitals operating their own KODSC. Meanwhile, approximately 39% of the cases were reported by partner hospitals participating in the network.

In relation to the total number of reports, organic chemicals emerged as the most common risk factor associated with these health issues, comprising 20.5% of the cases. This was followed by mineral dust, which accounted for 12.9%. Subsequent risk factors included biological elements such as gases, metals, acids, and alkalis. Welding fumes were suspected as the causative agent in 3.5% of the incidents. In 5.3% of the cases, identifying a probable risk factor was not feasible due to privacy or consent limitations during the reporting process, which hindered further investigation of the workplace (Table 3).

The most commonly reported condition was "Injuries involving multiple body regions, poisoning, other traumas," which includes acute poisoning, the primary focus of the surveillance system, accounting for 28.6% of all reports. Respiratory diseases were present in 23.8% of the cases, and cancer was reported in 301 cases (Table 4). Considering that workers' compensation recognizes only about 500 chemical exposure-related illnesses annually, the surveillance system captures a broader spectrum of milder illnesses, complicating direct comparisons. Nevertheless, it proves effective in uncovering the broader scope of issues beneath the surface.

Some reported cases were sentinel cases of high public health importance that urgently required government intervention. For example, in Seoul, a case of toxic hepatitis linked to trichloromethane in a cleaning product was reported. Following confirmation of this case, an ad hoc medical examination of all workers using the product identified six additional cases of toxic hepatitis. In Gwangju, a case of blood cancer potentially caused by benzene exposure prompted a thorough assessment of workplace conditions and biological monitoring of the workers. Lastly, in Daegu, a reported case of acute arsine

poisoning, along with several other serious illnesses in the workplace, initiated an investigation into provisional medical examinations and compliance with relevant laws and regulations.

Conclusion

More workers are being approved for compensation for work-related illnesses because the workforce is aging and various occupational factors exacerbate workers' health problems. Workers engaged in multiple or short-term, precarious jobs are particularly vulnerable to acute poisoning, especially if they lack familiarity with their work environments or the chemicals they handle. There is a growing academic and policy focus on socio-psychological risk factors, such as work hours and stress [25]. However, due to shifts in the labor market, health issues are increasingly being examined in sectors with a high concentration of vulnerable workers, such as construction [26] and gig labor [27]. The labor market's increasing polarization and flexibility have resulted in a diverse group of workers who fall outside the protection of the current occupational health system and workers' compensation insurance. Consequently, implementing full-time surveillance systems in hospitals has become a crucial policy tool [28].

The KODSC is a regional hospital-based surveillance system designed to detect occupational diseases, including acute poisoning. Established in April 2022, it builds on the experiences of various surveillance systems in Korea. Despite its recent inception, the KODSC has successfully identified previously unrecognized occupational diseases of varying severity. It specifically addresses cases of acute poisoning that necessitate immediate intervention in the workplace and contributes to the establishment of national prevention policies through prompt action.

The foundational structure for strengthening the promotion and delivery of occupational health services involves collecting, analyzing, and disseminating data on workers' health at the national level [29]. In this context, the KODSC plays a crucial role as it is a publicly funded, hospital-based system that allows

the government to continuously monitor various occupational diseases. Utilizing the KODSC, data on occupational diseases can be generated to aid in the planning and implementation of policies. This enables us to address critical questions like, 'What is the most important and urgent problem?' Addressing this question is the initial step in resolving public health issues.

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Conflict of interest

No potential conflict of interest relevant to this article was reported.

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Data availability

The data are available upon request.

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Supplementary materials

Not applicable.

References

1. Kang SK, Kim EA. Occupational diseases in Korea. J Korean Med Sci 2010;25(Suppl):S4-12. https://doi.org/10.3346/jkms.2010.25.S.S4

2. Korean Women's Development Institute. Gender Statistics [Internet]. Seoul (KR). [cited 2024 Nov 10]. Available from: https://gsis.kwdi.re.kr/statHtml/statHtml.do?orgId=338&tblId=DT_2EB0209N&conn_path=I2

3. Japan Industrial Safety & Health Association. Fatal occupational injuries per 100'000 workers in ILOSTAT (2012 - 2022) [Internet]. Tokyo [JP]. [cited 2024 Nov 10]. Available from: https://www.jisha.or.jp/english/statistics/202310_38.html

4. Peter Lundberg, United Nation Montenegro. World Health and Safety Day: A healthy working environment as fundamental work right [Internet]. [cited 2023 April 28]. Available from: https://montenegro.un.org/en/257596-world-health-and-safety-day-healthy-working-environment-

fundamental-work-right

5. Rushton L. The Global Burden of Occupational Disease. Curr Environ Health Rep 2017;4(3):340-348. https://doi.org/10.1007/s40572-017-0151-2

6. Coggon D. Estimating population burdens of occupational disease. Scand J Work Environ Health 2022;48(2):83-85. https://doi.org/10.5271/sjweh.4007

7. Lele DV. Occupational Health Surveillance. Indian J Occup Environ Med 2018;22(3):117-120. https://doi.org/10.4103/ijoem.IJOEM_251_18

8. Soucie JM. Public health surveillance and data collection: general principles and impact on hemophilia care. Hematology 2012;17 Suppl 1(01):S144-146. https://doi.org/10.1179/102453312X13336169156537.

9. Thacker SB, Birkhead GS. Surveillance. In: Gregg, MB, ed. Field epidemiology. Oxford, England: Oxford University Press; 2008. p. 38-64.

10. Smith PF, Hadler JL, Stanbury M, et al. Blueprint version 2.0: updating public health surveillance for the 21st century. J Public Health Manag Pract 2013;19:231-239.

11. Choi SB, Lee S, Lee W. Status and prediction of disapproval of the Korean workers' compensation insurance for diseases and injuries. J Occup Health 2023;65(1):e12392. https://doi.org/10.1002/1348-9585.12392

12. Ministry of Employment and Labor. Analysis of Industrial Accidents in 2022 [Internet]. Sejong [KR]. [cited 2023 Dec. 22]. Available from : https://www.moel.go.kr/policy/policydata/view.do?bbs_seq=20231201612

13. Kang SK, Jee YG, An YS, et al. Status and prospects of national surveillance. Korean J Occup Environ Med 2001;13(2):116-126. [Korean]

14. Ryu HW, Kim EA. A coverage estimation of workplace environment measurement and specialty

medical exam. KOSHA. 2017 [Internet]. Available form: https://www.kosha.or.kr/oshri/publication/researchReportSearch.do?mode=view&articleNo=408187&attachNo=

15. Ryu J, Lim KH, Ryu DR, et al. Two cases of methyl alcohol intoxication by sub-chronic inhalation and dermal exposure during aluminum CNC cutting in a small-sized subcontracted factory. Ann Occup Environ Med 2016;28:65. https://doi.org/10.1186/s40557-016-0153-9

16. Do SY, Lee CG, Kim JY, et al. Cases of acute mercury poisoning by mercury vapor exposure during the demolition of a fluorescent lamp factory. Ann Occup Environ Med 2017;29:19.

17. Shin MY, Park JS, Park HD, Lee J. HCFC-123-induced toxic hepatitis and death at a Korean fire extinguisher manufacturing facility: a case series. Ann Occup Environ Med 2018;30:20. https://doi.org/10.1186/s40557-018-0231-2

18. Hwang JH, Kim JI. A case report of toxic hepatitis caused by chloroform in automotive parts manufacturer coating process. Ann Occup Environ Med 2022;34:e22. https://doi.org/10.35371/aoem.2022.34.e22

19. Kwon SC, Song J, Kim YK, Calvert GM. Work-Related Asthma in Korea - Findings from the Korea Work-Related Asthma Surveillance (KOWAS) program, 2004-2009. Allergy Asthma Immunol Res 2015;7(1):51-9. https://doi.org/10.4168/aair.2015.7.1.51

20. Leem JH, Kim HC, Ryu JS, et al. Occupational lung cancer surveillance in South Korea, 2006-2009. Saf Health Work 2010;1(2):134-139. https://doi.org/10.5491/SHAW.2010.1.2.134

21. Koh DH, Park JH, Lee SG, et al. Development of Korean CARcinogen EXposure: An Initiative of the Occupational Carcinogen Surveillance System in Korea. Ann Work Expo Health 2021;65(5):528-538. https://doi.org/10.1093/annweh/wxaa135

22. Min YS, Lee S, Kim M, Ahn YS. Rheumatoid arthritis in low-level toluene-exposed workers based on nationwide medical surveillance data in Korea. Am J Ind Med 2021;64(4):245-250. https://doi.org/10.1002/ajim.23226

23. Min YS, Ahn YS. Central nervous system diseases of organic solvents exposed workers based on nationwide medical surveillance-data in Korea. Am J Ind Med 2016;59(5):392-398. https://doi.org/10.1002/ajim.22568

24. Rutstein DD, Mullan RJ, Frazier TM, Halperin WE, Melius JM, Sestito JP. Sentinel Health Events (occupational): a basis for physician recognition and public health surveillance. Am J Public Health 1983;73(9):1054-1062. https://doi.org/10.2105/ajph.73.9.1054

25. Kang HT, Kim CJ, Lee DW, et al. Statement by the Korean Society of Occupational and Environmental Medicine on the proposed reform of working hours in South Korea. Ann Occup Environ Med 2023;35.e17.

26. Lee S, Kim YJ, Kim Y, Kang D, Kim SC, Kim SY. Incidence rates of injury, musculoskeletal, skin, pulmonary and chronic diseases among construction workers by classification of occupations in South Korea: a 1,027 subject-based cohort of the Korean Construction Worker's Cohort (KCWC). Ann Occup Environ Med 2023;35.e26.

27. Kim MS, Oh J, Sim J, Yun BY, Yoon JH. Association between exposure to violence, job stress and depressive symptoms among gig economy workers in Korea. Ann Occup Environ Med 2023;35.e43.

28. Yang L, Branscum A, Kincl L. Understanding occupational safety and health surveillance: expert consensus on components, attributes and example measures for an evaluation framework. BMC Public Health 2022;22(1):498. https://doi.org/10.1186/s12889-022-12895-6. PMID: 35287647; PMCID: PMC8922762.

29. Kang DM. Problems and suggested improvement plans for occupational health service in Korea. Ann Occup Environ Med 2023;35:e10. https://doi.org/10.35371/aoem.2023.35.e10

Tables

Table 1. History of the occupational disease surveillance system in Korea

Category		Details	Period
Occupational disease surveillance	**Disease-oriented**	Asthma	1998-2002, 2004-2011
		Musculoskeletal disorders	2000-2004
		Skin disorders	1998
		Mesothelioma and leukemia	2001
		Mesothelioma	2002-2013
		Lung cancer	2006-2010
		Lymphohematopoietic disorders	2007-2010
		Injury	2008-2011
		Cerebro- and cardiovascular diseases	2010-2011
	Region-oriented	Incheon	2001-2010
		Busan, Ulsan, and Gyungnam	2001-2003, 2005-2010
		Gumi	2002-2003
		Changwon	2004
		Jungbu-Nambu Regional Lung Cancer and Leukemia	2011-2016
Exposure monitoring		Construction workers	2002

	Needle stick injury	2009-2013
	DMF (dimethylformamide) biological exposure indices monitoring	2010
Mixed type	Petroleum industry	1999-2000
	Workplace-oriented occupational disease surveillance	2011-2012
	Acute poisoning disorders	**2016-2020**

Table 2. Reported cases in 2023

Suspicious case reports					Investigation		Total
KODSC OPD or Adm	**KODSC ER**	**Partner Hospital**	**Others**	**Total**	**Risk Investigation**	**Investigation Support**	
1,306 (30.1%)	509 (11.7%)	1,700 (39.2%)	826 (19.0%)	4,341 (100.0%)	24	33	4,389

Table 3. Suspected risk factors for reported cases in 2023

Risk Factors	Number	%
Organic chemicals	888	20.5
Mineral dusts	560	12.9
Biological factors	349	8.0
Gases	316	7.3
Metals	284	6.5
Acids or alkalis	256	5.9
Asbestos	214	4.9
Ultraviolet	214	4.9
High temperature	178	4.1
Welding fume	154	3.5
Hypoxia	92	2.1
Wood dust	58	1.3
Metalworking fluids	40	0.9
Man-made fibers (glass fibers)	13	0.3
Ionizing radiation	6	0.1
Abnormal barometric pressure	3	0.1
Others	484	11.1
Unknown	232	5.3
Total	4,341	100

Table 4. Disease classifications of reported cases in 2023

Disease classification		Number	%
A	Infection	46	1.1
B	Virus or parasite	76	1.8
C	Malignant neoplasm	301	6.9
D	Benign neoplasm, hematologic or immune	34	0.8
E	Endocrine, nutritional and metabolic	6	0.1
F	Mental and behavioral	4	0.1
G	Nervous system	32	0.7
H	Eye and adnexa, ear and mastoid process	374	8.6
I	Circulatory system	76	1.8
J	Respiratory system	1,034	23.8
K	Digestive system	26	0.6
L	Skin and subcutaneous tissue	259	6
M	Musculoskeletal system and connective tissue	21	0.5
N	Genitourinary system	26	0.6
R	Symptoms, signs and abnormal clinical and laboratory findings	247	5.7
S	Injuries	69	1.6
T	Injuries involving multiple body regions, poisoning, other traumas	1,241	28.6
U	Codes for special purposes	1	0
V	Transport accidents	1	0
W	Other external causes of accidental injury	9	0.2
X	High temperature	272	6.3
Y	Event of undetermined intent	1	0
Z	Factors influencing health status and contact with health services	110	2.5
Unknown		75	1.7
Total		4,341	100

Figure Legends

Fig. 1. The organizations of Korea Occupational Disease Surveillance

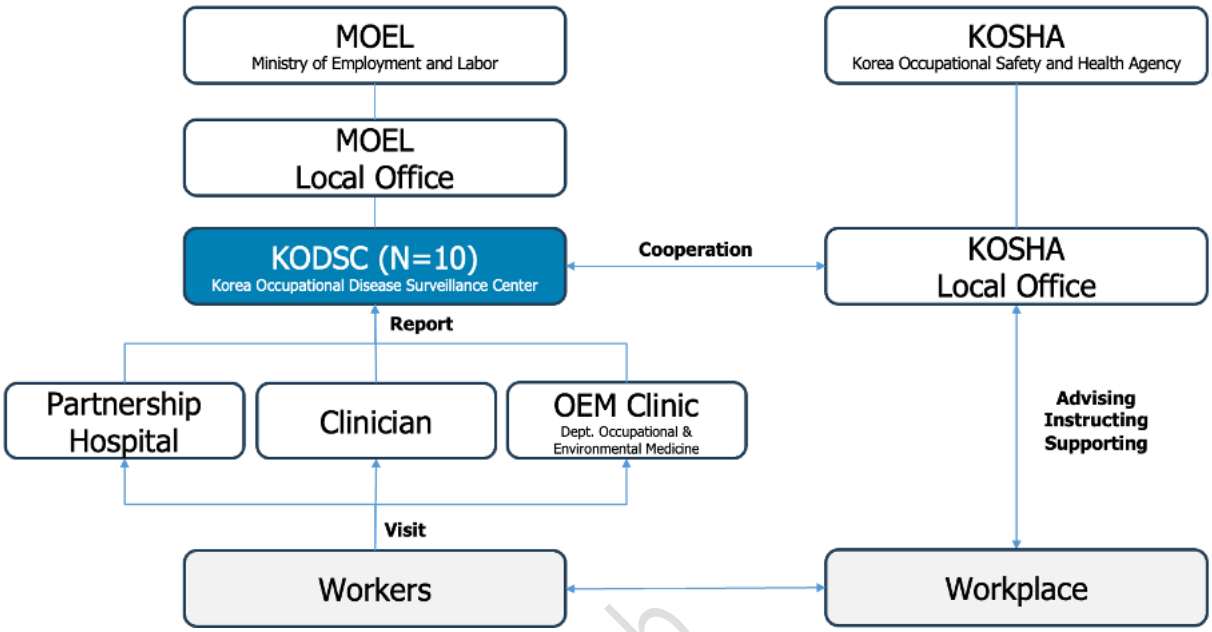

Fig. 2. The organization of each Korea Occupational Disease Surveillance Center