

Proficiency in Occupational Medicine Practice of Occupational Physicians in Thailand: A Qualitative Study (In-Depth Interview)

Ruethairat Kaewkul, MD¹, Phanumas Krisorn, MD, MSc¹, Naesinee Chaiear, MD, MMedSc, PhD¹

¹ Department of Community, Family and Occupational Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand

Background: Occupational physicians (OPs) can lead to substantial economic costs due to work-related injuries and diseases, including early retirement, skill loss, and increased medical and insurance expenses. These have led the American College of Occupational and Environmental Medicine (ACOEM) established competencies for OPs.

Objective: To investigate the occupational medicine practices among physicians in Thailand according to residency training in preventive medicine, or occupational medicine, course in various settings including medical residency training institute, tertiary hospital, and company or factory.

Materials and Methods: The present study was a qualitative design research by structural in-depth interviews. The study sample consisted of 15 OPs, selected through criterion sampling. The research tools included a structured interview form with two parts, 1) personal information, 2) competency of OPs in practice according to the World Federation of Medical Education (WFME) Standard.

Results: Twelve out of 15 OPs (80%) participated in the present study. The findings revealed that the predominant workplace was in tertiary hospitals at 58.33%. These physicians mainly conducted fitness for work and return to work assessments for 75%, which requires compliance with legal mandates. Medical emergencies in workplaces were less often addressed, with 66.67% of physicians reporting infrequent handling. They attributed this to the limited regulations. Notably, adherence to the Occupational Safety and Health Administration (OSHA) medical surveillance standards was low, showing a preference for the Thai over global regulations. Fit for work assessments were common, averaging 48 cases per month, while disease investigation was minimal, at less than one case per month. Confidence levels mode was five points across most of the competencies, with lower confidence in conducting occupational disease investigations due to low volume of cases.

Conclusion: Fitness for work assessment was the most proficient and frequently used practice among Thai OPs. The practice of OPs should adhere to the clear laws and guidelines to ensure the expertise of OPs in performing their duty effectively.

Keywords: Competency; Proficiency; Occupational physicians

Received 10 April 2024 | Revised 28 April 2024 | Accepted 1 May 2024

J Med Assoc Thai 2024;107(7):505-13

Website: <http://www.jmatonline.com>

The landscape of occupational medicine is a critical global concern, affecting millions of lives and the economic fabric of societies⁽¹⁾. The European Union's Strategic Framework for 2014-2020 highlights the alarming statistics related to work-related diseases, which are responsible for approximately 2.4 million deaths annually worldwide, with around 200,000 of these occurring

in Europe alone⁽²⁾. Beyond the immeasurable human cost, work-related injuries and diseases impose significant economic burdens on individuals, employers, governments, and societies at large. By estimation, such adversities account for 3.9% of the global GDP and 3.3% of the EU's GDP, underscoring the profound societal and economic impacts of occupational hazards⁽³⁾. The burden of work-related disease and injuries increases globally⁽⁴⁾. The overall workers death rate continues to increase, with the majority of deaths taking place in poorer countries with fewer legal protection for workers⁽⁵⁾.

The development of legislative frameworks and institutions, such as the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Safety and Health Review Commission (OSHRC), alongside the academic contributions, have significantly shaped the field^(6,7). Furthermore,

Correspondence to:

Krisorn P.

Department of Community, Family and Occupational Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002, Thailand.

Phone: +66-43-363588

Email: phankr@kku.ac.th

How to cite this article:

Kaewkul R, Krisorn P, Chaiear N. Proficiency in Occupational Medicine Practice of Occupational Physicians in Thailand: A Qualitative Study (In-Depth Interview). *J Med Assoc Thai* 2024;107:505-13.

DOI: 10.35755/jmedassocthai.2024.7.14006

international efforts have aimed to standardize core competencies for occupational physicians, emphasizing the importance of clinical practice, hazard assessment, and management in occupational health.

In Thailand, the field of occupational medicine is relatively nascent⁽⁸⁾, and there was little research on the competency of occupational medicine physicians, including the results being diverse and the research outcomes differing in directions^(9,10). Residency training in occupational medicine began in 2003, initiated by Chulalongkorn Hospital, Thai Red Cross Society and in 2019, the World Federation of Medical Education (WFME) was implemented⁽¹¹⁾. The competency of occupational physicians included 1) fitness to work and return to work (RTW) assessment, 2) health promotion, 3) medical surveillance, 4) diagnosis of occupational disease or injury, and 5) field epidemiology and disease prevention. This differed from Khon Kaen University, which has added medical emergency in workplace⁽¹²⁾. However, due to the framework of the law, it might not support working according to competencies as much as it should⁽¹³⁻¹⁵⁾. This can be observed from the statistics of work-related injuries and disease, which remain high, and the diagnosis of occupational disease is underreported⁽¹⁶⁾. There are disparities in training quality and the practical application of occupational health principles across various sectors. The present paper aimed to explore and assess the proficiencies of occupational medicine practice among physicians in Thailand, focusing on the diverse environments of medical residency training institute, tertiary care centers, and industrial settings. Through the present study, the authors seek to contribute to the broader discourse on improving occupational health standards and physician competencies, and to develop occupational physicians training in Thailand.

Materials and Methods

Research design

The present study was a qualitative study, with structured in-depth interview.

Participants

The sample size of 15 participants was determined through criterion sampling, ensuring that each participant met the specific definitions and inclusion criteria relevant to their subgroup, 1) occupational physicians in occupational medicine training institute, 2) occupational physicians in general hospital, but hospitals must have a dedicated occupational

medicine clinic and physicians with a minimum of three years of experience, and 3) occupational health doctors in factory or company setting, as a full-time or part-time occupational physician in companies or engaged doctors with at least two years of experience under yearly contracts.

Data collection

In-depth interviews were conducted using a structured questionnaire that had been evaluated for content validity by two experts.

The questionnaire consisted of two main sections, 1) personal information, and 2) the performance according to the competencies of residency training program certified by medical council. This comprised 10 questions, which were 1) participant's age, gender, years of experience and graduated institute, 2) fitness to work and RTW assessment, 3) health promotion, 4) medical surveillance, 5) diagnosis of occupational disease or injury, 6) field epidemiology and disease investigation, 7) medical emergency in workplace, 8) average number and diversity of service cases, 9) confidential level to service, and 10) other opinions about workload and residency training program of the medical council according to WFME standard. Proficiency in occupational medicine practice is performing up to the standard of the occupational medicine⁽¹⁷⁾. The interviews were conducted in a location preferred by the participants such as a quiet room or online meeting and the researcher conducted the data collection personally. The researcher met the participants before conducting the interview, to build a good relationship with the participant to create trust and lead to the disclosure and genuine information. Each interview lasted 60 to 90 minutes. The record of data was secured in locked location on password protected computer accessible only by the researchers.

Data analyses

Descriptive statistics were used to describe the participant's demographic characteristics. Data were analyzed using quantitative content analysis, and data collection was stopped when saturation was reached.

Ethical approval

The Khon Kaen University Ethics Committee for Human Research reviewed and approved the ethical considerations following the Declaration of Helsinki and ICH Good clinical practice Guideline (approved number HE651375).

Results

Demographic characteristic

Out of 15 participants, 12 (80.0%) participated in the present study. Three individuals who did not participate in the research were two from a medical residency training institute and one company doctor. All participants were male, aged 30 to 39. Most were alumni of Chulalongkorn Hospital or the Thai Red Cross Society, the others from Nopparat Rajathanee Hospital and Khon Kaen University. The main workplaces were tertiary hospitals for 58.3%, followed by medical residency training institute for 25.0%, and private sectors for 8.3%, with 90% having business as a secondary workplace. The work locations were predominantly in the Eastern and Northeastern regions for 33.3% and Central regions for 25.0%, and most participants have 5 to 9.99 years of work experience (Table 1).

The most and the least utilized competency

The competencies of occupational physicians revealed that 75.0% were most frequently utilizing skills in fitness for work (FFW) and RTW assessments, while medical surveillance was utilizing 25.0% of the time (Table 2). Two experts explained that the reason for this aligned with the demand of the labor market. Therefore, cases that came in often revolve around FFW was the primary concern. The number of cases was also high in most of expert's experience, which the median was 48 cases per month. Seven experts said that more than half of the cases in their occupational medicine practice was FFW due to mostly working in the hospital. Twelve experts primarily evaluated confined spaces and used the main standards of the association of occupational and environmental disease of Thailand, covering all cases. However, currently, they all could do without an opened book. The following FFW evaluated were food handlers by 10 experts, and commercial drivers by nine experts. For RTW, 10 experts performed this task. The case were around three to five cases per week. The most common type of cases were injuries as seen by eight experts, stroke by four experts, and post infection by four experts. Some cases were referred from other specialists as seen by two experts, who were occupational physicians and could provide better and more appropriate opinions. Most experts were confident in conducted RTW as mentioned by eight experts, except for some cases that two experts found challenging such as cardiovascular disease.

The least utilized competency was managing medical emergencies in the workplace, at 66.7%,

Table 1. Demographic characteristic

Personal information (n=12)	Number	Percent
Sex		
Male	7	58.3
Female	5	41.7
Age (years)		
30 to 39	10	83.3
40 to 49	1	8.3
50 to 59	1	8.3
Graduating Institute		
Chulalongkorn Hospital, Thai Red Cross Society	4	33.3
Nopparat Rajathanee Hospital	4	33.3
Khon Kaen University	3	25.0
Birmingham University	1	8.3
Primary workplace		
Tertiary hospital	7	58.3
Medical residency training institute	3	25.0
Private hospital	1	8.3
Company/factory	1	8.3
Secondary workplace		
Company/factory	9	75.0
Private hospital	1	8.33
None	2	16.7
Workplace		
Eastern	4	33.3
Northeastern	4	33.3
Central	3	27.3
Northern	1	8.3
Years of experience		
1 to 4.99	2	16.7
5 to 9.99	7	58.3
10 to 14.99	2	16.7
15 to 19.99	0	0.0
≥20	1	8.3

followed by medical surveillance, diagnosis, and treatment of occupational diseases, at 16.7% (Table 2). Based on six experts, this was because the primary responsibility in hospital lay within the emergency department. Additionally, two experts explained that hospitals often had toxicologists' assistance. Expert no. 6, and 11 stated that workplaces already had emergency programs in place. Expert no. 1 stated that some facilities already had personnel designated for this role, such as safety officers. However, it was still considered important because it is believed that it would still be utilized. Regarding the involvement of occupational medicine physicians, they were typically involved in the process of writing emergency plans for chemical spills, but this was not executed due to lack of management interest. In

Table 2. Attitudes to the competency of occupational physicians

Attitudes to the competency of occupational physicians (n=12)	Number	Percent
Most utilized competencies		
Fitness for work and return to work	9	75.0
Medical surveillance	3	25.0
Diagnosis and treatment of occupational disease	0	0.0
Medical emergency management in workplace	0	0.0
Health promotion	0	0.0
Field epidemiology and disease investigation	0	0.0
Least utilized competencies		
Medical emergency management in workplace	8	66.7
Medical surveillance	2	16.7
Diagnosis and treatment of occupational disease	2	16.7
FFW and RTW	0	0.0
Health promotion	0	0.0
Field epidemiology and disease investigation	0	0.0

FEW=fitness for work; RTW=return to work

the event of an incident, the occupational physicians might be involved in the incident commander team or decontamination, as well as assisting in the placement fire extinguishers and training first aiders and contributing to writing plans and collaborate with the hospital's environmental committee (expert no. 3).

Here were the example quotes of experts.

Expert no. 4: "Mostly use is fitness for work. The top common cases are confined space, followed by food handler, and lastly driver. The standard used for confined space is the association of occupational and environmental disease of Thailand, for food handler is FDA food code and the guideline from public health (Thailand) and for commercial driver is DVLA and FMCSA. I got done a lot because there was interaction and dealing with factories. Some days, I assessed fit for work for about 10 to 20 cases, for the confidence level is five because I have done a lot, and it is our work."

Expert no. 11: "In the labor market, fit for work assessment is quite significant due to a large number of workers and numerous subcontractors with legal restrictions, medical certificates that expire within one month. The cases that I have done were confined space, food handler, and working at height. The confidence level is five, and the standard use of confined spaces and working at height are from the association of occupational and environmental disease of Thailand and for food handler is from the guideline from public health (Thailand)."

Expert no. 12: "Fit for work, such as drivers, offshore, and confined space. These groups have clear

job titles, mostly follow guidelines from associations and use suggestions from companies. These groups will have clear job titles."

Expert no. 3: "In RTW, I have done mostly in health care workers. The majority of personnel are affected by infectious diseases such as COVID-19, TB, and encounter musculoskeletal disease after physical therapy. For the factory cases like amputations often RTW with loss assessment. After assessment, there usually are not many problems, and the hospitals have nurses follow up after RTW assessment."

Expert no. 1: "In most emergencies, factories already have personnel handling, such as safety officers. In team of emergency preparedness in hospital, there was the team for emergency preparedness but helping in provide the information for the chemical."

Expert no. 5: "Emergency preparedness is primarily handled by the ER team, but there is collaboration in providing chemical information and conducting post-exposure surveillance, including emergency drills like chemical spills. In such cases, the occupational medicine physician acts as the incident commander and oversees decontamination."

Expert no. 9: "Diagnosis of occupational disease cases from the factory have been conducted but infrequently, due to visiting the factory once a month. However, it takes a considerable amount of time, possibly due to delays in confirming cases."

Medical surveillance

Medical surveillance was the most interesting competency due to difference attitude from participants. Three experts defined as the most utilized competency while two experts defined the least. Medical surveillance is an activity that 11 experts undertake due to health examination regulatory requirements. Furthermore, five experts also use this activity to teach both medical students and resident doctors. Every expert had conducted medical surveillance, although the volume of work varied as eight experts conducted at least one to three times a month, while four experts did no more than three times a year. Eleven experts were confident that they performed it correctly. However, upon reviewing the completeness of the medical surveillance process, it was found that only one expert fully executed all nine essential steps. In contrast, 11 experts did not complete all the steps. The steps experts often miss included medical removal by 11 experts and medical exam and ongoing data analyses by 10 experts. Eleven experts only reach the stage of designing

components of the medical surveillance program.

Here were the example quotes of experts.

Expert no. 1: “Regularly occurs seasonally, averaging about once a month. Factories request assistance from hospitals or through private hospitals, particularly for interpreting environmental monitoring results, which are usually straightforward. After receiving environmental monitoring results following a walk-through survey, compare them with the HRA using Notification from the Ministry of Industry Establish industry product standards and health check-up practices based on chemical and physical risk factors from occupations in the workplace B.E. 2555, for noise and HSE standards. Once completed, the results are sent to the factory, but physical examinations of the workers are not conducted. This is managed by the factory. However, for consultancy, there is a comparison with the baseline for both chemicals, looking at trends in biological monitoring, and noise, due to legal issues.”

Expert no. 4: “There is a walk-through survey to assess the design of medical surveillance for factories based on hazards. For noise, HSE guideline and OSHA standards are used. For chemicals, HRA is applied, or the semi-quantitative methods of Manpower Singapore are used depending on the context. Since HRA is easily communicable, safety officers from each factory will understand it to varying degrees. There is one factory that adopts American standards as the action level.”

Expert no. 6: “Not frequent for hospitals, only three times a year, specifically for high-risk groups like central sterile supply department, medical technicians, forensic medicine, laundry, and chemotherapy. Some departments assess themselves using ACGIH values and design based on risk, after assessment in the hospital, schedule examinations and follow-up according to the department.”

Field epidemiology and disease investigation

No experts gave the opinion that field epidemiology was either the most or the least utilized competency. However, the field epidemiology was the competency for which experts had the least confidence in performing, with a median score of 4. Twelve experts had experience in conducting single case investigations, which were investigations to diagnose causes related to work. However, only two experts had actually conducted field epidemiology. Eight experts had experienced in investigation events no more than once or twice per year.

Here were the example quotes of experts.

Expert no. 1: “Investigation reports might not have many issues, such as with COVID-19, but were difficult to conclude what is work-related COVID-19 and what is not. In the past I used to investigate workers using a pipet that caused De Quervain’s disease, ACL tear, but not many investigations. We do not investigate outbreaks because while the hospital knows and we know, the factory does not let us in, and at the hospital, it is the job of epidemiology department. The most recent case was incorrect chlorine liquid filling into a tank.”

Expert no. 2: “Still relatively new, but if it is a lead-related factory, I have done quite a lot. Cases found at the OPD clinic and cases from the compensation fund committee, diagnosing work-related or not work-related injuries, cases from the fund for investigation or finding cases to investigate. I had to find cases myself because factories rarely allow entry, usually cases of rashes/dizziness from paint spraying. Finding cases for nurses/residents to learn.”

Expert no. 11 “All post-exposure surveillance work is infectious control job, both COVID-19 and TB in case of infectious diseases in the hospital. Investigating confined space, sulfuric overexposure, fell into a pit and fainted, coordinated with the Department of Labor Protection and Welfare a long time ago. When there is a work accident, the hospital goes out to investigate.”

Medical emergency in workplace

Medical emergency preparedness and response and health promotion were the two competencies in which most experts had little experience and exhibited a considerable variety of practices. Ten experts responded that the health promotion activities they engage in often was health education that did not measure outcomes, and 10 experts had been involved in designing emergency response plans, but not as the main contributor, just as part of the team. Five experts were involved in the emergency preparedness process as well.

Research

Research was a topic of considerable debate among experts. Five experts said that they had been involved in research, with four experts publishing at least one paper per year. Meanwhile, three experts had not published any work in the past three years, and two experts were not interested in conducting research or publishing at this time. Four experts viewed research as beneficial for career advancement, and regarding the opinion that research was a

requirement for becoming a specialist in the medical residency training program. Six experts believed that it should be reduced and focus more on clinical occupational medicine training than before, as it was more frequently used in real life.

Here were the example quotes of experts.

Expert no. 6: “Advisor for resident’s research project infrequently, not more than one topic per year, have not really done any under my own name.”

Expert no. 9: “Not at all.”

Expert no. 1: “It is good as it is, agree with the master’s degree approach to balancing the weight. Being strict to a certain extent is enough, but it may not be necessary to be too strict, TCII should be achievable. The standards for entering TCII might be difficult. Being too strict could be challenging, affecting other skills such as management, negotiation, and communication with non-medical personnel.”

Expert no. 11: “I think doing just one research paper is enough, but as a thesis. Increase activities for residents, improve systematic thinking processes, synthesize knowledge, such as developing medical guidelines, have self-learning skills, and communicate with other interdisciplinary professionals.”

Discussion

In this qualitative research, in-depth interviews were used to enable us to understand the detail in each topic deeply⁽¹⁸⁾. Twelve participants joined the present research, and the data collected had reached saturation from content analysis. In the present study, 75% of occupational physicians primarily focused on fitness to work assessments, driven by regulations⁽¹⁵⁾. Conversely, only 66.67% dealt with medical emergencies in the workplace, a lesser focus due to minimal regulatory guidance and the typical delegation of emergency responsibilities to other medical professionals in hospitals. To ensure the role of occupational physicians, authority has to define role and should have clear specification of duties in the law or guideline, both in the hospital and workplace.

FFW evaluations were a core competency for occupational medicine physicians. This aligns with global research that places disability and fitness assessments among the top three competencies worldwide⁽¹⁹⁾. Legally mandated by the regulation⁽¹⁵⁾, these assessments were compulsory for employees exposed to specific jobs, with occupational medicine specialists required to conduct health exams. This is especially pertinent for confined space work,

governed by the ministry standards⁽²⁰⁾, necessitating medical certification for employees. Legal and guideline recommendations were varied, including food handlers regulated by the 2018 Ministry of Public Health’s Act (B.E. 2561) and international standards like Good Hygiene Practice (GHP), Hazard Analysis and Critical Control Point System (HACCP), and Food and Drug administration (FDA) food code. Although Thailand lacks specific legal requirements for driver fitness, many businesses adhere to international standards leading to a high volume of driver examinations by occupational physicians and the standard use is the Driver and Vehicle Licensing Agency (DVLA) and Federal Motor Carrier Safety Administration (FMCSA). Firefighter examinations, despite the National Fire Protection Association (NFPA) standard, are less common due to Thailand’s absence of specific guidelines, highlighting the legal and guideline-driven nature of FFW assessments in occupational medicine.

RTW assessments are crucial in occupational medicine, driven by the Ministerial Regulation B.E. 2563 (2020)⁽¹⁵⁾. This regulation mandates that employees absent for three or more days due to work-related risk factors must have an RTW assessment by a treating, establishment, or occupational physician before resuming work. The majority of RTW cases involve injuries, aligning with the Social Security Office data (2018-2022)⁽²¹⁾ that identifies workplace injuries as predominant. Musculoskeletal diseases followed as the second most common cause for RTW assessments. Conversely, healthcare workers primarily undergo RTW assessments for infectious diseases, reflecting sector-specific risks⁽²²⁾. Standards for RTW vary by condition with the American Medical Association (AMA) providing guidelines for injuries and post-surgery fitness, whereas the Centers for Disease Control and Prevention (CDC) sets the standards for infectious diseases.

Medical surveillance is a critical competency for occupational medicine physicians as it is required annually for employees who work with risk factors as the Ministerial Regulation B.E. 2563 (A.D. 2020)⁽¹⁵⁾. Despite its importance, adherence to the full OSHA medical surveillance standards is low, with only one physician in compliance^(23,24). The practice follows the Thai guidelines⁽²⁵⁾, which specify three steps compared to OSHA’s twelve, focusing on biological and health effect monitoring. This highlights a significant gap in comprehensive medical surveillance practices, including RTW protocols and record-keeping, underscoring the need for improved

adherence to international standards.

Field epidemiology involved investigating epidemics and outbreaks to enhance public health and prevent disease spread⁽²⁶⁾. In occupational settings, it typically focuses on diagnosing individual cases of work-related diseases such as de Quervain's disease, low back pain, or injuries, and investigations due to the requirement under the Occupational and Environmental Diseases Act, B.E. 2562⁽¹³⁾ rather than broader disease control efforts. In hospitals, this task often falls to epidemiologists or infectious control units, with oversight from Hospital Accreditation (HA)⁽²⁷⁾ bodies and potentially other committees beyond occupational physicians.

In health promotion, only 25% of participants fully implemented all four steps⁽²⁸⁾, indicating that many initiatives might be limited to health education rather than comprehensive health promotion. Programs primarily focus on non-communicable diseases (NCDs) and occupational diseases, driven by the high mortality rate from NCDs in Thailand and the low cost-effectiveness of prevention compared to treatment⁽²⁹⁾. Additionally, legislation requires businesses to inform employees about work-related diseases annually, as mandated by the Ministerial Regulation B.E. 2565⁽³⁰⁾ for safety operations in workplaces.

Research was recommended to be reduced by the experts, which may be due to the Thai curriculum that already involve too much research, which differ from the global study of competency where research was the last three bottom rank competencies of occupational physicians⁽¹⁹⁾.

Strength

The strength of the present study is the findings on the proficiency of occupational physicians according to the guidelines of the WFME, reflecting their practical work capability.

Limitation and suggestion

The present research primarily involves physicians working in hospitals. It may not fully address the perspective of full-time company doctors. Future research could further explore the issues related to full-time company physicians.

Conclusion

FFW assessment is the most frequently used practice and most proficient among Thai occupational physicians. The practice of occupational medicine physicians should adhere to clear laws and guidelines

to ensure the expertise of occupational physicians in performing their work.

Recommendation

Increasing the role of occupational physicians in the labor law will highlight more significant role of occupational physicians and be used to develop an occupational physician training in Thailand.

What is already known on this topic?

Occupational physicians have a key role in preventing disease and promoting wellbeing for workers. The field of occupational medicine in Thailand is relatively nascent.

What does this study add?

Understanding the challenges and practices in occupational medicine in Thailand highlights the impact of legal and professional requirements on medical practices, informing policy development to enhance the standards in workplace. The extracted data were used to improve further training such as fire fighter.

Acknowledgement

The authors would like to thank the participants for giving their interview for the present study.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Nicholson PJ. Occupational health: the value proposition. London: Society of Occupational Medicine; 2022.
2. European-Occupational Safety and Health Administration. Work-related diseases [Internet]. Washington, DC: EU-OSHA; 2022 [cited 2022 Apr 21]. Available from: <https://osha.europa.eu/en/themes/work-related-diseases>.
3. European-Occupational Safety and Health Administration. Good OSH is good for business [Internet]. Washington, DC: EU-OSHA; 2022 [cited 2022 Mar 6]. Available from: <https://osha.europa.eu/en/themes/good-osh-is-good-for-business>.
4. Nurminen M, Karjalainen A. Epidemiologic estimate of the proportion of fatalities related to occupational factors in Finland. *Scand J Work Environ Health* 2001;27:161-213.
5. LaDou J, London L, Watterson A. Occupational health: a world of false promises. *Environ Health* 2018;17:81.
6. American College of Occupational and Environmental Medicine. The history and future direction of ACOEM and occupational and environmental medicine

- [Internet]. 2002 [cited 2022 Mar 6]. Available from: <https://acoem.org/acoem/media/PowerPoints/ACOEMSlides.pdf>.
7. Westerholm P. History and development of training in occupational medicine. *TBV – Tijdschrift voor Bedrijfs- en Verzekeringsgeneeskunde* 2008;16:424-31.
 8. Banthukul A. Image of the future of occupational medicine doctors. *Gotoknow* [Internet]. 2012 [cited 2022 Apr 14]. Available from: <https://www.gotoknow.org/posts/364467>.
 9. Sitthirarumkul P, Bandhukul A. Competency of occupational physicians. *Thammasat Med J* 2019;19:206-10. [in Thai]
 10. Kittikawin N, Bandhukul A, Rattanamongkolgul S. The cross sectional survey of occupational medicine specialties opinion about occupational medicine physician competency in Thailand by modified Delphi technique. *Thammasat Med J* 2013;13:181-94. [in Thai]
 11. The Association of Occupational and Environmental Diseases of Thailand. Curriculum and criteria for training resident doctors for a certificate showing knowledge and expertise in assembly medical profession in the field of preventive medicine occupational medicine branch Occupational and Environmental Diseases Association of Thailand (Under the Preventive Medicine Association) [Internet]. 2018 [cited 2022 Apr 16]. Available from: <https://www.aod.org/organization/history>.
 12. The Association of Occupational and Environmental Diseases of Thailand. Curriculum and criteria for training resident doctors for a certificate showing knowledge and expertise in assembly medical profession in the field of preventive medicine occupational medicine branch Occupational and Environmental Disease Association of Thailand (Under the Preventive Medicine Association) [Internet]. 2018 [cited 2022 Apr 16]. Available from: <https://www.aod.org/ocmed/wfme/standard1/extra3/>.
 13. Control of occupational diseases and environmental diseases Act B.E. 2562 (A.D. 2019). *Government Gazette Vol. 136, Part 67a*, dated 22 May 2019. [in Thai]
 14. Announce of Ministry of Public Health: Rules, procedures, and conditions for appointing qualified members in the Committee for the Control of Occupational Diseases and Environmental Diseases B.E. 2562 (A.D. 2019). *Government Gazette Vol. 136, Special part 291d*, dated 26 Nov 2019. [in Thai]
 15. Ministerial regulations set the standard for employee health checks relating to risk factors B.E. 2563 (A.D. 2020). *Government Gazette Vol. 137, Part 80a*, dated 5 Oct 2020. [in Thai]
 16. Benavides FG, Ramada JM, Ubalde-López M, Delclos GL, Serra C. A hospital occupational diseases unit: an experience to increase the recognition of occupational disease. *Med Lav* 2019;110:278-84.
 17. AG5 Skills Management Software for Regulated Industries. Competency vs. proficiency: Understanding the differences and their importance for skills development [Internet]. Amsterdam: AG5; 2023 [cited 2024 Apr 27]. Available from: <https://www.ag5.com/competency-vs-proficiency-understanding-the-differences-and-their-importance-for-skills-development/>.
 18. George T. Structured interview definition, guide & examples [Internet]. London: Scribbr; 2022 [cited 2024 Apr 27]. Available from: <https://www.scribbr.co.uk/research-methods/structured-interviews/>.
 19. Demou E, Lalloo D, Macdonald EB. Differences in opinions of occupational physicians on the required competencies by field of practice: results of an international Delphi study. *BMC Med Educ* 2018;18:62.
 20. Ministerial regulation on the prescribing of standard for administration and management of occupational safety, health and work environment in confined space B.E. 2562 (A.D.2019). *Government Gazette Vol. 136, Part 18a*, dated 15 Feb 2019. [in Thai]
 21. Social Security Office, Thailand. The situation of occupational injury or work-related illness from 2018 to 2022 [Internet]. 2023 [cited 2024 Mar 24]. Available from: https://www.sso.go.th/wpr/assets/upload/files_storage/sso_th/102220b2a37b7d0ea4eab82e6fab4741.pdf.
 22. Chaiear N, Su A. Proportion of the medical school personnel who completely resume to their original work after sickness absence. *Srinagarind Med J* 2020;35:203-9. [in Thai]
 23. Woradee T, Chaiear N, Krisorn P. Medical surveillance followed the U.S. OSHA standard: A study in large manufacturing factories, the Eastern Economic Corridor of Thailand. *J Med Health Sci* [Internet]. 2023 [cited 2024 Apr 21];30:11-25. Available from: <https://he01.tci-thaijo.org/index.php/jmhs/article/view/265685/179189>.
 24. Occupational Safety and Health Administration. Medical screening and surveillance requirements in OSHA standards: a guide [Internet]. 2014 [cited 2024 Mar 24]. Available from: <https://www.osha.gov/sites/default/files/publications/osha3162.pdf>.
 25. Notification of Ministry of Industry: Establish industry product standards, health check-up practices based on chemical and physical risk factors from occupations in the workplace B.E. 2555 (A.D. 2012). *Government Gazette Vol. 129, Special part 105d*, dated 4 Jul 2012. [in Thai]
 26. Rasmussen SA, Goodman RA. The CDC field epidemiology manual [Internet]. Atlanta: Centers for Disease Control and Prevention; 2018 [cited 2024 Mar 24] Available from: <https://www.cdc.gov/eis/field-epi-manual/index.html>.
 27. The Healthcare Accreditation Institute. Hospital and health care standards. 5th ed. Nonthaburi: Healthcare Accreditation Institute; 2021.

28. Centers for Disease Control and Prevention (CDC). Workplace health model [Internet]. Atlanta: CDC; 2024 [cited 2024 Mar 24]. Available from: <https://www.cdc.gov/workplacehealthpromotion/model/index.html>.
29. Tuangratananon T, Julchoo S, Phaiyarom M, Panichkriangkrai W, Pudpong N, Patcharanarumol W, et al. Healthcare providers' perspectives on integrating NCDs into primary healthcare in Thailand: a mixed method study. *Health Res Policy Syst* 2021;19:139.
30. Notification of Ministry of Industry: The provision of safety officers, personnel, departments, or committees for safety operations in business establishments, B.E. 2565 (A.D. 2022). *Government Gazette* Vol. 139, Part 39a, dated 17 Jun 2022. [in Thai]