

Occupational Medicine Approaches to Controlling Emerging Diseases and Enhancing Occupational Health Outcomes

Tayebeh eghbali1

Department of Nursing, Faculty of Nursing and Midwifery, Kermanshah University of Medical Sciences, Kermanshah, Iran

ABSTRACT

Occupational medicine serves as a cornerstone for promoting worker health, preventing illnesses, and addressing evolving workplace risks driven by globalization, technology, and emerging diseases. This narrative review aims to explore interventions for controlling emerging diseases and enhancing occupational health outcomes, including workplace surveillance systems, vaccination and PPE programs, health literacy initiatives, mental health considerations in emergencies, equity and inclusivity efforts, and the influence of organizational and policy frameworks. It summarizes the state of the science, highlights challenges and opportunities through expert perspectives, and encourages interdisciplinary dialogue to inform future practices and close research gaps.

Key themes encompass conceptual foundations, defining occupational health, emerging diseases, and multidisciplinary practices that integrate clinical care, public health, and safety amid converging hazards. Theoretical models discussed include the hierarchy of controls for risk reduction, ecological approaches to interconnected health determinants, infectious disease transmission models for targeted interventions, and the Total Worker Health® framework, which holistically addresses physical, psychosocial, and chronic health overlaps to build resilience. The historical evolution traces the field's origins from Bernardino Ramazzini's 1700 work on occupational hazards, through Industrial Revolution legislation like the UK's Factory Act of 1833, to modern expansions incorporating infectious control post-COVID-19.

Significant reflections reveal occupational medicine's adaptation to global crises, with recent studies showing improved surveillance, risk assessments, and vaccination efficacy in sectors like healthcare and manufacturing, reducing absenteeism and vulnerability. Challenges such as socioeconomic inequities, antimicrobial resistance, and gig economy alterations emphasize the need for adaptable, contextually relevant protections. Overall, the review concludes that occupational medicine's proactive, evidence-based evolution is essential for integrating with public health to safeguard workers against complex threats, fostering resilient global systems.

Keywords: Emerging diseases, Health equity, Occupational medicine, Total Worker Health, Workplace surveillance

1. INTRODUCTION

Occupational medicine is one of the primary methods to promote occupational health and prevent occupational illnesses and is vital in protecting the health and well-being of workers in various industries[1]. Occupational health frameworks have become increasingly held back by new health hazards and emerging diseases as the workplace continues to evolve with advancements in technology and microeconomic forces due to globalization[2]. The increasing complexities point to the importance of occupational medicine for dealing with new infectious diseases and novel workplace exposures that could threaten worker safety or productivity, including the management of chronic disease with a traditional occupational health risk approach[3]. To deal with the evolving risks, occupational medicine applies interdisciplinary clinical frameworks of basic clinical knowledge, occupational epidemiology, and preventative principles to support a vital global and local role of occupational medicine in the promotion of workplace and public health[4].

Occupational medicine has undergone tremendous evolution since its birth during the industrial revolution when worker health was primarily focused on physical trauma and exposure to toxic substances[5]. The

milestone events that shaped an essential understanding of the occupational hazards included, among others, the descriptions of what would now be considered occupational diseases such as silicosis and the enactment of legislation aimed at workplace hazards and safety[6]. Most recently, as a result of global health disasters such as the COVID-19 pandemic, occupational medicine has expanded its definition to include infectious disease control in workplace environments[7]. During the past five years, studies have demonstrated improved surveillance systems, risk assessments, and creative preventative approaches to new pathogens in a variety of high-risk occupational sectors, including manufacturing, transportation, and healthcare[8]. Occupational medicine remains a relevant field, and there is an ongoing review of literature during this time period which examined the effectiveness of vaccination programs among essential workers, and new rapid response strategies for overcoming epidemics[9].

Pressures from global challenges, such as the continued emergence of new infectious agents, climate change, and the increase in telework and gig economy jobs which alters traditional risk profiles, add to the relevance of occupational medicine as a means of preventing future disease emergence and enhancing occupational health outcomes[10]. Ongoing conversations have emphasized the essential need for improved integration of occupational health with public health programs, recognizing the role of workplaces for disease prevention and disease transmission[4]. Existing literature suggests that socioeconomic inequities, limited access to healthcare, and changing conditions of employment make some occupational groups more vulnerable to new disease emergence.[11] For example, with zoonotic diseases related to the changing environment, antimicrobial resistant infections, and the need to adopt occupational medicine practice that advances collaborative interdisciplinary models and timely data exchange, proactive occupational medicine practice is warranted[12, 13]. These challenges highlight the necessity for occupational medicine professionals to remain informed and adaptable in order to provide robust protection plans that are contextually relevant while being scientifically evidence based[14].

This narrative review will discuss several key topics related to occupational medicine interventions aimed at improving the health of working populations and preventing emerging diseases. They include workplace-based surveillance and rule-out systems, intervention programs including vaccination, PPE, and health literacy, and technology-based monitoring and control of workplace-related safety hazards included in occupational health intervention[15]. In addition the review will discuss the importance of mental health-related issues within workplace settings and health emergencies[16], the importance of equity and inclusivity with occupational health initiatives, and organizational and policy contexts that either hinder or provide support for the delivery of occupational health programs[14]. The aim of this narrative review is to inform future aims in the field, to close research gaps and highlight issues through the lens of investigators engaged in research and practice in occupational health, and to summarize the state of the science and the challenges, and promises demonstrated in the use of occupational medicine to develop prevention protocols for emerging diseases to control infections[17, 18]. This review is a summary of evidence and context for expert opinions, to inform a greater understanding of occupational medicine, and how it can contribute to the improvement of worker health in the face of ever-changing and complex health threats[19]. Finally, the review aims to encourage interdisciplinary conversation and exploration of future innovative evidence-based practices to strengthen occupational health systems globally[20].

Conceptual and Theoretical Background

Occupational medicine is a specialized discipline that focuses on preventing, diagnosing, and treating occupational illnesses, injuries and accidents, while promoting and maintaining workers' health[21]. Some key words that are relevant to occupational medicine include: "occupational health" which relates more broadly to the physical, mental, and social health of employees in connection with their workplace; "emerging diseases" that are related to infections or illnesses that are newly developed or more frequently recognized and pose new health risks[22]; and "occupational medicine practices" which typically are clinical, preventive, and/or policy-related interventions to protect and promote the health of employees [۲۳]. Occupational medicine, therefore, deals with all things clinical care, public health, and work-related safety, applied in a multidisciplinary conceptualization of a fluid and ever-changing context[24]. At the core of this discussion is the understanding that the workplace is one of a kind, where exposure to biological, chemical, physical, and psychosocial hazards converge, affecting traditional occupational health matters, but also controlling the spread of newly emerging infectious disease[25].

There have been several theoretical models established to help understand the links between occupational medicine and health at work or health promotion and disease prevention as they relate to employment[26]. At a practical level, risk reduction efforts continue to be expressed in terms of the traditional 'hierarchy of

controls' related to the priority of controlling risks e.g. removal or elimination of the hazard, substitution, engineering controls, administrative controls and the last consideration of personal protective equipment[27]. From a more population-based, theoretical perspective, the 'ecological model' of occupational health interprets health outcomes of workers as the result of interconnected and interdependent variables based on individual gains, organizational returns, community benefits, and/or policy objectives[28]. This complex model supports comprehensive approaches that understand the workplace risks while also addressing broader social determinants of health[29]. In more recent years, the application of the 'Infectious Disease Transmission Model' in certain occupational scenarios to target specific routes of transmission associated with pathogens within a workplace has made it possible to consider more sophisticated and targeted interventions such as immunization, contact tracing and outbreak response models[30]. For example, research conducted during the past five years demonstrates how this model could be applied in healthcare contexts to establish COVID-19 exposure prevention measures that are effective and increase worker safety through layers of control measures[27].

Another important theoretical perspective is the "Total Worker Health®" method associated with the National Institute for Occupational Safety and Health (NIOSH)[31]. The Total Worker Health method acknowledges health promotion and occupational safety and health protection as a way to better account for the full breadth of worker health[32]. This method describes how the full continuum of workplace organization, psychosocial stressors, and chronic health issues overlap with developing diseases to create total occupational health outcomes[33]. As the Total Worker Health programs, which include flexible work structures and mental health services provide, the indirect effects of emerging infectious diseases impact worker resiliency, recent studies suggest [34]. Evidence from sectors such as manufacturing and agriculture that were affected significantly by the COVID-19 epidemic, for instance, reveals that when occupational medicine employs a holistic model, employee health outcomes improved and absenteeism rates decreased[35].

Another important theme in occupational medicine theory is equality and resilience[36]. Workplaces with precarious employment or socio-economic inequalities are vulnerable to emerging disease threats[37]. According to "vulnerability frameworks" recently advanced by scholars, social factors and power relationships are necessary considerations and should be a part of any occupational health risk assessment and control strategies[38]. Occupational medicine's equity-driven approaches that prioritize issues like resource allocation, culturally competent communication, and participatory decision-making, are also relevant to protect vulnerable worker groups, according to recent literature[39]. These perspectives are further bolstered in idea of resilience, which attends to the organization's and workforce systems' adaptive capacity in the face of novel health hazards[40]. Integrating these ideas into occupational medicine usefully positions us to deal with the biological risks, and many of the social and organizational determinants of health, that are occurring[41].

Collectively, these theoretical and conceptual foundations indicate how occupational medicine is evolving as it responds to new diseases and seeks to improve health outcomes in different work environments[42]. They also highlight the need for multidisciplinary, multilevel interventions that are grounded on science and informed by context, to help identify futures for both research and practice in this important area of public health[43].

Historical Development and Evolution

The historical development and evolution of occupational medicine methods to improve occupational health outcomes and control emerging diseases can be delineated through a series of important eras defined by changing paradigms, contributions of science, and significance milestones[44].

The origins of occupational medicine can be seen as early as the beginning of the 18th century with Bernardino Ramazzini, known as the "Father of Occupational Medicine[45]." In 1700, Ramazzini published the book "De Morbis Artificum Diatriba" (Diseases of Workers) which systematically included the health hazards associated with over 50 different occupations and emphasized the need to investigate occupational-related illnesses[46]. This text connects a worker's health and environment, and thus the emergence of the discipline evolved over the next centuries, first describing injuries, exposure to harmful substances, or a combination both during the Industrial Revolution era[47]. The workplace was changing rapidly during the age of expansion within industry which led to higher incidences of accidents and occupational diseases[48]. The increased recognition of injury and disease increased the urgency for legislative initiatives such as the UK's Factory Act of 1833, aimed to regulate workplace environments and identify initiatives to reduce risk of injuries and ill health[49].

Occupational medicine advanced in both technical and organizational capacity in the late 19th and early 20th centuries[50]. In the United States, trailblazers like Alice Hamilton conducted groundbreaking research on workplace hygiene and industrial pollutants that ultimately helped to improve industrial safety regulations[51]. The mobilization of occupational health as a distinct medical and quasi-regulatory profession was revealed by the establishment of national organizations like the National Institute for Occupational Safety and Health (NIOSH) shortly afterward, and the Occupational Safety and Health Administration (OSHA) in 1970[52]. Expanded preventative practices and connection to public health systems came about from the extensive recognition of the benefit of occupational health service to maintaining worker productivity and public health during and after World War II[53].

In the late 20th century and early 21st century, occupational medicine gained substantial traction. It transitioned the occupational attention from physical threats to chronic illness, mental well-being, and most significantly, infectious diseases[54]. The notable aspect of this shift is the emergence of international health threats such as HIV/AIDS in the 1980s, and the COVID-19 pandemic. For example, COVID-19 showed that occupational medicine is essential to managing the risks of contagious diseases; through immunization, health surveillance, outbreak response, and mental health supports for employees in high-risk industries like manufacturing and healthcare[55]. These uses of occupational medicine have displayed the inclusion of newly researched knowledge and advances in new technology while being reactive to current health concerns[23]. In addition, the theoretical advancements of the "Total Worker Health®" approach have expanded the occupational medicine purview by linking safety, health, and health equity[56]. There has been an increasing acknowledgment of social determinants of health and the vulnerabilities of marginalized workers, leading to developing strategies aimed at multidisciplinary collaboration and resilience building at the organizational and policy levels. In this way, occupational medicine has developed into a more holistic discipline that continues to control and monitor conventional occupational hazards and addresses complex, multifactorial risks related to emerging diseases and altered work settings globally[55].

To summarize, occupational medicine has progressed from its earlier roots of disease detection and hazard control, to a more extensive and proactive paradigm of worker health. Several factors, ranging from advances in science and industry and technology, from legislative milestones and global health crises, shaped the evolution of occupational disease control; leading to the unique and adapted systems for occupational health and disease control that we recognize today[57]. As we consider this historical context, it serves as vital baselines for understanding current occupational medicine practices, and possible future directions to protect worker health, amid an evolving world[57].

Current Trends and Key Issues

Recent years have shown some important trends in occupational medicine, which reflect a changing paradigm in the management of emerging illness and the promotion of occupational health and safety[23]. One such trend is the increasing incorporation of technology, including important support from telemedicine, digital health platforms, and real-time data analytics, for better early diagnosis and illness surveillance in the workplace[58]. This allows for more proactive monitoring of occupational exposures and novel infectious threats, with urgency and targeted response[59]. Additionally, the increasing incorporation of Total Worker Health® concepts is another example of how occupational medicine services have expanded their scope from traditional medical services to include mental health support and a more comprehensive approach to worker well-being[60]. The regional developments and diversity of occupational health resources is another interesting topic[61]. While Asia-Pacific markets are experiencing this huge rise because of both industrial growth and improved regulatory frameworks, North America is working around a mature infrastructure[62]. These developments reflect a general understanding about the value of occupational health in maintaining public health in a changing work environment and the implications for labour productivity[47]. There are logical market insights that are developing. Adapting occupational medicine frameworks to accommodate the complexity of new diseases is a current problem and topic of conversation, especially considering the recent global health emergencies (e.g., COVID-19)[23]. Balancing emerging infectious disease dynamics with traditional hazard control strategies is a complex problem that requires layered approaches to prevention that incorporate behavioral interventions, environmental controls, personal protective equipment (PPE), and vaccination interventions[63]. In addition, the rise of non-traditional workplaces such as gig economy jobs and remote work complicates the occupational health risk assessment and intervention delivery processes[64]. Equity issues have also come to the fore, raising awareness about the inequalities faced by vulnerable worker populations who are exposed to higher risk in the workplace and have lower access to healthcare[65]. This includes those in precarious employment, migrants, and people working in the unorganized sector, who may

not have safety precautions or health insurance[66]. In order to be responsive and culturally sensitive to emerging risks, there are still discussions about the best ways to institutionalize occupational health equity in policy and practice[67].

Occupational medicine has both opportunities and challenges with the rapid development of biomedical and technology research. New breakthroughs in immunotherapy, gene editing, and vaccine science offer great potential for addressing the control of infectious diseases in occupational settings[68]. Novel vaccines made from nanoparticles and gene editing technologies such as CRISPR are defining the new frontiers of preventative medicine that may allow us bespoke interventions for specific populations of high risk workers[69]. Nonetheless, factors such as cost, ethical considerations, worker consent, and regulatory approval are significant barriers to implementing these advancements into an occupational health context[70]. Similarly, the development of AI diagnostic and telemedicine capabilities is leading to a revolution in delivering clinical care; however, this requires flexible occupationally safe work areas and additional data security measures[71]. Occupation medicine will also be affected by the ongoing post-pandemic "after-shocks" that have involved adjusting the infectious disease departments suggesting that interdisciplinary collaboration, talent development and appropriate resource allocation will be pre-requisites to successfully respond to future unexpected dangers[72].

Another key trend is the increased emphasis in occupational health policies and standards on mental health and resilience[73]. This emphasis is overdue and, as we have seen in the pandemic times, the psychological stressors associated with new outbreaks of disease and epidemics take the form of social isolation, disruptions at work, and fears of disease transmission, and together establish a need for an integrated way of providing mental health interventions and treatment as part of the occupational medicine landscape[74]. Crisis counseling programming, mental health promotion in workplaces, and flexible work arrangements all result in higher employee engagement and lower absenteeism, leading to better overall occupational health[75]. When contemplating how to maintain outcomes in occupational health in a conflicted global health context, organizational adaptability, resilience-building, and systemic and legislative contexts related to social justice and equity in resource allocation appear to be a more viable pathway than recent ADA-related policies and best practices alone[76]. All of this suggests an occupational medicine field that is more multinational, technologically based, and conscious of equity, navigating the barriers it faces to protect and advance the health of workers amid a context of new infectious disease exposure and uncertainty[77].

Applications and Practical Implications

Occupational medicine contributes importantly to worker health and safety in the world by translating theoretical frameworks and research findings into new activities across a wide range of industries[23]. Industry examples of activities include thorough assessments of contingencies (hazard assessments) and the implementation of multitiered systems of control including engineering controls, administrative controls, and personal protective equipment (PPE) that reduced exposure to biological and chemical risks[78]. For example, in order to prevent workplace transmissions of COVID-19, many manufacturing and healthcare organizations instituted contact tracing, vaccination promotion, and enhanced environmental controls[79]. These interventions highlighted the fundamental role of occupational medicine in operational resilience and productivity, as it helped protect workers while continuing to provide necessary services[80]. Comprehensive employee health programs that integrate chronic disease management, mental health support, and infectious disease monitoring draw from occupational medicine in healthcare settings[23]. Healthcare organizations are able to manage the complex interplay between emerging infectious threats and employee wellness in the context of broad, integrated paradigm, including utilizing the Total Worker Health® framework[81]. Examples of contemporary practices are tailored immunization programs for frontline workers, real-time monitoring technologies for exposure tracking, and telehealth interventions to monitor population health at a distance[82]. In order to additionally protect workers and patients, occupational medicine providers partner with infection control specialists to develop and implement rapid response plans for containment[83]. These examples demonstrate the versatility of the field in responding to emergent evidence and advancing public health in the midst of a public health crisis[84].

As awareness and preparedness for new disease hazards increases, more occupational medicine concepts have started being incorporated into the courses and curricula for safety officers and organizational management staff, and for those in health care services[80]. Universities and professional associations provide specialized courses and workshops on many aspects of occupational hazard recognition, legal and regulatory frameworks, and how occupational health also must advance health equity in the workplace[85]. One area of growing emphasis in occupational health education is training on the use of artificial intelligence

systems for predictive risk assessment and early outbreak detection[86]. In sharing this information, institutions promote a proactive culture, committed to the prevention of illness and promotion of worker health, and they also have a better-informed workforce[87].

These policy-level applications recognize the impact of occupational medicine beyond individual workplaces[88]. Policy-makers will look to occupational medicine to inform their policies and guidelines regarding how regulations get shaped to bring workplace safety standards and emerging disease control; the evidence can come from the rationale that underlies recommendations in occupational health[23]. National and international labor policies, many of which include pandemic preparedness frameworks and response strategies, are all influenced by the evidence base of occupational health[89]. When operationalizing new guidelines with vulnerable worker populations, such as migrant labor and gig workers, policy makers will seek occupational medicine data to develop programs that are inclusive towards occupational health while facilitating equitable access to protective measures and a suite of healthcare services[90]. Interdisciplinary interaction such as working with occupational health specialists can enhance the design of workplace health programs that are sustainable, align public health goals, and ultimately support resilience in the face of biological threats in terms of societal health[91].

When considered as a complete set of uses, these exemplars illustrate the potential of occupational medicine research and theory to effectively implement interventions to enhance occupational health outcomes and control new diseases in numerous real-world contexts[23]. In addition to decreasing current hazards, occupational medicine creates adaptable systems that engage with science and practice (and seek to promote an optimal balance of these) with the advantage of being able to act on the next emerging needs related to occupational health as they arise, and for the betterment of safe and healthy and productive workplaces the world over[92].

Critical Reflections and Gaps in the Literature

The current body of literature on occupational medicine's role in emerging disease control and occupational health outcomes demonstrates notable strengths, particularly in integrating multidisciplinary perspectives, advancing surveillance technologies, and emphasizing holistic worker health frameworks such as Total Worker Health®[54]. Recent studies effectively highlight the dynamic adaptation of occupational medicine to contemporary infectious threats, especially during global crises like the COVID-19 pandemic, where vaccination campaigns, PPE use, and outbreak response have been extensively documented[55]. Furthermore, the incorporation of mental health and resilience-building into occupational health strategies signifies an important evolution in addressing the psychosocial dimensions of workplace health under emerging disease stressors[93]. These developments reflect a growing recognition within the field of the complexity and interconnectedness of biological, environmental, and social determinants impacting worker health[94].

Despite these advances, there remain multiple limitations and inconsistencies in the literature. One major issue is the underdiagnosis and underreporting of occupational diseases that distorts epidemiological information and affects the ability to determine the true burden of these diseases[95]. Reports from Taiwan, as well as other areas, illustrate how access to health care and difficulties with diagnosis lead to large underestimations of occupational diseases; some reports suggest that in some cases the underreporting could be as high as 40%. Underreporting of these diseases complicates allocation of resources and developing targeted treatments[96]. In addition, due to the fact that the vast majority of the present research is overwhelmingly accumulated in high-income countries with occupational health systems in place, little is known about exposures, disease burden and intervention effectiveness in low- and middle-income contexts[97]. Thus, the scarcity of data over a cross-regional spectrum undermines the potential of occupational medicine programs to be globally generalizable and equitable[98].

The complexity of exposure-response relationships and the diversity of developing disease risks in the workplace is another major void in the literature[99]. While real-world occupational exposures are complex mixtures of chemical, physical, biological, and psychosocial factors acting for various durations, much of the applied research focuses on singular hazards or diseases in isolation[100]. The need for comprehensive life-course exposure assessments is highlighted by new methodologies such as the exposome; although integrative research is nascent and has methodological issues[101]. Similarly, there is little research on worker groups that are vulnerable and marginalized, such as gig economy, migrant, and informal workers, who are at a greater risk due to socioeconomic situation and lack of access to health care[102]. There are still no practical applications, despite calls in the literature for more equity-based occupational health research that

incorporates culturally relevant communication and participatory approaches to intervention development[103].

While technology brings with it the potential for new opportunities, it introduces complexity as well. New technologies ranging from AI-enabled diagnoses, telehealth, and digital monitoring all offer potential tools for new disease control, however, we know very little regarding their effectiveness in a myriad of workplaces, data privacy issues, and equitable accessibility[104]. The ethics literature often overlooks issues of employee consent and potential discrimination. Occupational medicine is also burdened with challenges to implement evidence-based practices in a fast and reliable way given the rapid pace in biomedical innovation (e.g., gene intervention and new vaccine and delivery innovations)[105].

Recent research projects have begun filling some of these gaps. For example, the Exposome Project for Health and Occupational Research has inspired researchers to tackle exposure interactions and sex-specific effects and has helped to clarify the framework for multi-exposure assessment[106]. The significance of outbreak response research to inform knowledge gaps about emergent pathogen dynamics in the workplace is gaining traction and promotes interdisciplinary collaboration and real-time data sharing[107]. Nonetheless, there remains a pressing unmet need for a coordinated global research agenda that emphasis large, heterogeneous cohorts, methodological rigor, and the inclusion of marginalized or understudied communities[101].

To sum up, while there is a strong body of available literature that provides an excellent framework for for understanding occupational medicine paradigms that lead to diseases, there are still significant voids in the areas of underreporting, complexity of exposures, equity, purposeful technology use, and geographic variation[108]. It will be crucial for these gaps to be mitigated through robust, inclusive, and innovative research so that effective occupational health interventions can be created and implemented in a developing global workplace that is increasingly complex and connected[55].

Research Background

In the last one hundred years, occupational medicine strategies used to improve occupational health outcomes and deal with emerging diseases have evolved greatly, and reflect changes in scientific knowledge, health priorities and industrial practices around the globe[109]. The underlying conceptual basis was laid by the earliest landmark work such as Bernardino Ramazzini's, *De Morbis Artificum Diatriba* (1700), which dealt mostly with physical and chemical hazards and indicated a direct connection between industrial exposures and disease[110]. As the 20th century rolled on key institutional advancements like the establishment of NIOSH and OSHA in the US placed occupational health on the research agenda and within regulatory frameworks (Haagsma, 2012)[111]. Over the past several decades, academic knowledge has increasingly informed a more expansive public health perspective, factoring in biological hazards and developing infectious disease exposures in occupational and work settings[112]. Notably, the Occupational Exposome Project (EPHOR) provides a multidimensional perspective on both numerous exposures contributing to the development of noncommunicable diseases, as well as exposure risk factors including shift work and diesel fumes (Peters et al., 2024)[113]. A constellation of international research that links together risk exposures across geographical boundaries and occupational groups, illustrates the complexity of biological, chemical and psychosocial risks and the importance of a multidisciplinary, holistic approach to contemporary threats to occupational health[114].

Local industrial sectors and public health problems have shaped the development of research in occupational medicine in Iran in terms of endemic diseases and worker health[115]. Earlier Iranian research provided baseline epidemiological data and knowledge of workplace hazards, and as it often focused on traditional occupational diseases emerging from mining industry and agriculture[116]. Some universities such as Shahid Beheshti University and Tehran University of Medical Sciences contribute to the field by establishing occupational medicine departments conducting research on interventions and surveillance[117]. The recent emphasis on programmatic aspects of infectious disease hazards for industrial and healthcare workers have, and can be attributed to the current COVID-19 pandemic and local emerging zoonotic diseases[118]. Local research often focuses on translation of global constructs that considers the sociocultural and socio-economic contexts, which considers the different resource constraints and workforce vulnerabilities present in other regions, notably westernized contexts, although there are similarities with the trends that would imply that mental health is increasingly integrated with prevention[119]. This comparative approach is valuable, as it helps us understand the contextual and link to global literature on occupational health in the middle eastern region[120].

When it comes to emerging diseases and occupational health outcomes, the scientific trajectory of occupational medicine demonstrates an ongoing expansion in breadth, depth, and thematic variety[121]. The discipline has gradually established itself as a broader field incorporating biological hazards and infectious disease control, made possible after focusing on the recognition of physical hazards and regulatory responses[122]. This was particularly evident during a public health period whereby notable health events increases the awareness of disease transmission in the workplace[123]. The amendments to the discipline of occupational health are indicative of a multidimensional definition of the term within the employment context and in recognition of multiple themes, including state-of-the-art technology employed in surveillance, employee wellness models like Total Worker Health®, and broader psychosocial and equity considerations[124]. In addition to a marked increase in attention to digital tools, realm of policy relevance, and concurrent concerns for inclusive health promotion, the data from both the national and international literatures suggests an ever-increasing linear compounding from hazard identification to complex risk management[125]. The disciplinary and geographic dispersion of the academic involvement signals an increased recognition of occupational medicine as a vital field uniting public health considerations, clinical care, and socioeconomic factors[126]. This body of literature reflects a solid and robust commitment to scholarly thought on occupational health issues over time and across boundaries, capturing a long history informed by new scientific knowledge, changing labor landscapes, and global health emergencies[127].

2. MATERIALS AND METHODS

This descriptive review takes a comprehensive and integrative approach to review the literature available on occupational medicine interventions that address emerging diseases and impacts on occupational health outcomes. The literature is evaluated mainly from ESR (year Environmental Social Research) sources including peer-reviewed journals, original books or articles, and reports from well-established and recognized institution in occupational health and public health. The review emphasizes the inclusion of studies or reports that were clearly occupational medicine-related interventions, frameworks or theoretical developments concerning disease control and worker health promotions. The review emphasizes recent literature, ideally over the past ten years, with a special focus on literature published in the last five years to capture current developments and modern challenges. Nonetheless, classic and historical texts are included to provide important context and to demonstrate the conceptual evolution of the discipline. The searching strategy included exploring multidisciplinary databases (e.g., PubMed, Scopus, Web of Science), exploring occupational health archives, and exploring reference sections for relevant sources not available in conventional databases. The results were organized chronologically and thematically to create a coherent narrative that highlighted conceptual frameworks, historical developments, current trends, practical considerations, and critical gaps in the literature. The review maintained a fairly academic and descriptive tone while bringing in different perspectives to comprehensively reflect on how occupational medicine contributes to managing emerging diseases and improving occupational health outcomes with various populations and contexts.

3. RESULT

The literature reviewed has shown that the field of occupational medicine is significantly different than it was when it first emerged during the Industrial Revolution, when occupational medicine initially focused on physical injury and the impact of exposures to hazardous materials, its scope has since broadened to the management of infectious disease, particularly in the context of global health emergencies, like the COVID-19 pandemic. Examples of key milestones in history include Bernardino Ramazzini's publication in 1700, "De Morbis Artificum Diatriba," that demonstrated relationships between worker health and work-related environmental hazards across 50 professions, or legislation, such as the UK's Factory Act of 1833, enacted in part to improve working conditions as a strategy to prevent injury and illness. The establishment of organizations, such as the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA), established in 1970, legitimated the field of occupational health and built capacity for preventive strategies, while also embedding occupation health within public health. Theoretical concepts, such as the hierarchy of controls that prioritizes the elimination of hazards rather than relying solely on personal protective equipment, and the ecological model which asserts that health of workers is shaped by the individual, organization, community, and policy, highlight the interdisciplinary nature of the field. The Total Worker Health® framework developed by NIOSH, brings together safety practices, health promotion, and psychosocial factors to address worker wellness holistically. Recent large-scale research conducted in the last five years reveals developments in surveillance systems, risk

assessment methodologies, and vaccination programs in high risk sectors such as healthcare, manufacturing, and transportation to better manage emerging infectious pathogens. Common threads in the literature include: addressing the convergence of biological, chemical, physical, and psychosocial hazards in the workplace; occupational medicine's importance in controlling potential pathogen spread; and the need to respond to the evolving hazards of globalization, technology, and climate change. Models of infectious disease transmission have also led to targeted interventions, including vaccination and outbreak response in professional settings . Data from COVID-19-affected industries shows that comprehensive models reduce absenteeism and build resilience among workers. In sum, findings highlight the important role of occupational medicine in promoting health equity and resilience through evidence-based and contextually relevant practices. A growing movement in the literature highlights the use of technology, including telemedicine, digital platforms, and real-time data, to monitor potential occupational hazards and infectious threats as early as possible. The expansion of occupational medicine into mental health support and the Total Worker Health® paradigm shift to a more comprehensive view of worker well-being beyond medical services is important. Regional developments are advancing rapidly in the Asia-Pacific region due to industrial growth and development of regulatory initiatives in the area, and North America focuses on established systems. Challenges include how to adjust current systems to consider emerging diseases like zoonotic infections, antimicrobial-resistant organisms, and the new workforce made of gig economy employees and other non-traditional employment that fundamentally changes risk profiles . Equity issues are especially important, because disadvantaged populations, such as migrants and precarious workers, face increased risks and limited access to healthcare. Biological innovations, such as nanoparticle vaccines and gene editing, have potential for personalized prevention, but barriers related to cost, ethics, and regulatory approvals remain. In practice, multiple layers of control are being incorporated in industries; we see examples of contact tracing, promoting vaccinations, and changing environments to reduce exposure to biological risk during outbreaks. In the healthcare sector, integrated programs that bridge chronic disease management, mental health support, and infectious disease surveillance have several benefits to promoting favorable outcomes and increasing resiliency. In recent months, educational programs have begun to integrate occupational medicine topics into the educational content for safety professionals and managers, specifically related to using artificial intelligence as a tool for risk assessment," and priority is placed on health equity. On the policy front, governments need to warrant regulations that embrace pandemic preparedness and equitable access to pandemic prevention and protective measures. Emerging themes reinforce the need for interdisciplinary collaboration, a targeted approach to resource allocation that promotes resilience, and culturally appropriate approaches to redress socioeconomic disparities overall and unique post-pandemic stressors in occupational health. Further indications from the existing occupational research literature suggest the expanding reach of technology in practicing occupational health as a complementary measure, these include: that of telemedicine, digital technology, and real-time data, that assist with early detection and monitoring related to workplace hazards and infectious diseases. Additionally, the field of occupational health is moving beyond just physical health to include prevention and promotion related to mental health supports and the Total Worker Health® model, as part of a significant shift in practice to a more holistic approach focused on the worker's total well-being -vs- just medical care in occupational health. The Asia-Pacific region is experiencing a fast-paced growth in industrial growth and regulatory improvements, while North America has been more focused on the systems it already has. Updating current practices for new diseases such as zoonotic infections and antibiotic-resistant bacteria is one of the difficulties. This is further complicated by the rise in nontraditional jobs like gig economy or remote work, as they require a change in the management of risks. Equity is certainly a major factor, since populations such as migrants and temporary workers are at a higher risk of exposure and have limited access to care. The emergence of new medical technologies such as nanoparticle vaccines and gene-editing tools create opportunities for individualized prevention strategies; however, costs, ethical issues, and regulation continue to inhibit utilization. In a variety of industries organizations are utilizing a number of strategies, such as monitoring contacts, promoting vaccinations, and modifying workplace environments to minimize exposure during outbreaks. In healthcare contexts, programs that integrate chronic disease management, mental health, and disease surveillance are demonstrating improved outcomes for individuals and health system strengthening. Education programs are beginning to engage with occupational health in the training of safety officers and managers with a two-fold focus on risk assessment via AI, and reducing bias in healthcare. Policies need to be initiated which prepare for future health emergencies and enable access to protective instruments to everyone. Common themes show that teamwork across disciplines is needed, cautious innovative spending to build stronger systems, and

culturally competent forms of engagement to address disparities in income and pandemic-related occupational stress.

4. **DISCUSSION**

The emerging themes in the literature demonstrate how occupational medicine is central to achieving the goals stated above, in particular through the interdisciplinary approaches taken to address new occupational threats and the linking of public health models[23]. The shift from managing hazards after they occur to prevent disease reflects an awareness by academics of how the effects of globalization and technologies have shaped vulnerabilities for workers[55]. Therefore, for the field to succeed, an integration of the disciplines of epidemiology and clinical practice and knowledge of practice implications is critical. Such change can be explained by the influences of social and economic determinants while drawing on prior knowledge[128]. Although historically, occupational medicine focused predominantly on physical hazards, now there is a more holistic view to address workplace exposures to potential infectious diseases[68]. Thus, the nature of the field to adapt is derived from its potential to promote interdisciplinary methods of inquiry rather than simply an innovations approach. At a theoretical level, this means that the conventional risk approach is evolving, or in transition, with psychosocial and biological factors emerging as areas of greater importance to understanding worker health[129]. This aligns with ecological models that view workplaces as a system affected by outside factors, such as climate change. In practice, these models illustrate how occupational medicine links the safety of an individual worker with the overall health of society, but they also illustrate how occupational medicine contributes to global conversations about equity and sustainability[130]. The literature situates occupational medicine not only as a type of medicine but as an examination of the work environment, to consider the degree to which work reflects and exacerbates public health issues, all of which provides a strong platform for the review to advocate for informed and evidence-based practice when navigating the complexities of the workplace[131].

The application of technology and fairness in workplace health plans today shows that the review first examined how to address new conditions through a defined purpose and equitable policies[132]. This illustrates how these components work together to rethink health at work. The impetus for this thinking comes from new energy after the pandemic, with digital tools and broadened understanding of health care, through expanded applications of Total Worker Health®, taking a more prominent place[55]. These will replace antiquated solutions that did not yield fruitful engagement in attempts to find a delicate balance between workplace efficiency and the responsibilities to worker care in varying contexts around the world[133]. This suggests that differences in context, like strategies around accelerated development compared to prior developed systems, are not just matter-of-factly developed but demonstrate the uneven nature of development, indicative of a fundamental fact that workplace health care must appreciate cultures and social contexts to have meaningful applications worldwide[134]. The emphasis on resilience and inclusion of mental health, acts as an anti-thesis to prior thinking by indicating more powerful manifestations of worker stress and challenges being shaped by a broader social context and not just a personal incapacity[135]. This indicates that examining how power relationships and resources are distributed is critical when assessing risks. All of these concepts have shown how workplace health protection is connected to population health[136]. Workplaces are critical points to curb the spread of disease and support maintaining optimal health levels for people. As a result, workplace health protection is a substantially larger arena to influence policies pertaining to equality and equity[137]. Examining these perspectives from the lens of the literature, these discoveries suggest that workplace health protection must utilize global capacity-building practices and technology to respond to the risks of today's workplace. It deepens the review of how to protect workers in ways that are adaptable to the situations in which they work[138].

The strengths and inconsistencies in the literature provides an important insight into the aims of this review, which is to highlight where research gaps exist and to review what is known[139]. This draws on an understanding of potential data biases stemming from methods and geography regarding health equity and innovation in work settings. The explanation for not reporting adequate detail or overly concentrating explanation on single hazards could stem from barriers to data collection and the prioritisation of high income areas[140]. The exclusion of risk for those in disadvantaged groups serves to accentuate inequities as there is no connection of an increased risk while demonstrating the plight for health equity; drawing attention to the need for a new methodology, such as the exposome to provide greater understanding[141]. Further, the issue indicates that the science has adapted well to different study areas and opportunities to assess behaviour change, however it has potentially neglected some ethical consideration in using new technologies[142]. Therefore, we had to consider whether rapid advancements could exacerbate gaps unless they were based on

an ethical framework, and enhanced instead of reduced access that could include everyone impacted. From a theoretical perspective, these findings challenge traditional conceptions of vulnerability by demonstrating how social conditions and biological risks jointly affect health[143]. From a broader applied academic context, these findings demonstrate the role of occupational medicine to public health and raise the issue of limiting generalization by not using enough examples of diversity in the review, although it raises the possibility of developing strength and resilience as discussed in the review, but if at all possible this would be based upon evidence-based deliberation[144]. Using a contextual model for these finding demonstrate how occupational medicine can bring together different perspectives to health related to medical practice, policy, and social aspects of occupational health, supporting its vital role in addressing new threats in a world with health challenges that are closely inter-related and evident across borders[145].

5. CONCLUSION

In summary, this review examines the evolution of the field of occupational medicine overtime, from its place at inception as workplace safety and hazard reduction to its focus in COVID-19 on new infectious disease response through the hierarchy of controls, ecological models and total worker health approach. The review illustrates the significance of the role of occupational medicine in surveillance of health, the use of vaccines and development equity based programs as we become more interconnected in the world, experience changes in technology, and face major health events such as the COVID-19 global pandemic. The review also illuminates challenges this field is facing in high-risk occupations and the newer types of work. The review explains the role of occupational medicine to situate the medical care worker's with public health to assist at work in the biological and mental arena using important laws and multidisciplinary teamwork. By highlighting various evidence, this review shows how this topic has evolved, the historical context of occupational medicine, and where the field is headed - connecting workplace health to societal context. This contribution enhances our understanding because it presents flexible and evidence-based approaches that look at more than just the usual risks, including climate change impacts and new technologies, which will be useful to people in health care and policy making. Ultimately, it demonstrates how important occupational medicine is to building equitable and sustainable health systems globally, enriching conversations within the field by acknowledging occupational medicine's powerful potential for disease prevention and health promotion.

From these primary points, the review proposes exciting future avenues for improving the knowledge and utility of occupational medicine. These avenues concentrate on addressing known problems such as regional data shortcomings, ethical dilemmas, and complex measures of exposure. For example, an investigation of climate change and the transition to greener processes on employment may uncover new risks in environmentally responsible practices. This would necessitate further research to protect workers from exposure as the environment changes. Likewise, an investigation into options to mitigate the spread of viruses in various work environments could develop potential interventions regarding air management systems and vaccination protocols, for example, to mitigate new exposures to pathogens in settings such as factories. Addressing issues with the evaluation of capabilities required to prevent illnesses, particularly within long-term care settings, may also assist in developing better workforce development tools and policy improvements, thus strengthening responses to outbreaks of diseases. Additionally, improve patient transport for care processes involving patients with infectious disease processes may enhance safety of healthcare workers during outbreaks through real-world practice exercises to reduce transmission. Furthermore, considering ways to support the workers who are at the frontline of disease outbreaks through the government and society may also produce new ways to manage workforce shortage and policy challenges, thereby creating stronger systems in settings that are neglected. These recommendations stem from the findings of the review, including the finding of limited outcomes reported and focus on distinct areas and encourage broader inquiry across disciplines in preparation for and mitigation of future threats.

In summation, occupational medicine is a versatile and adaptive specialty in a world of flux. It integrates prior knowledge, a thorough understanding of theory, and innovative evidence-based solutions to continually enhance worker health. The review emphasizes the need to advocate for the specialty's remarkable ability to be an agent of change to ensure safe workplaces, but also reminds us that protecting the health of workers is a critical pathway for getting society to advance. New challenges ahead emphasize that the specialty's expertise in empiricism and collaboration can take us forward with a healthy future, but it will require continued dialogue and commitment in order to advance a more capable and resistant workforce globally.

REFERENCES

- [1] Chicas, R., et al., Cooling intervention studies among outdoor occupational groups: A review of the literature. *American journal of industrial medicine*, 2020. 63(11): p. 988-1007.
- [2] LaDou, J. and R. Harrison, *Current occupational & environmental medicine*. 2007: McGraw-Hill New York.
- [3] Kriebel, D., et al., Risk factors for retinal detachment: A Case-Control Study. *Journal of occupational and environmental medicine*, 2020. 62(6): p. 445-451.
- [4] Pink, S., et al., Interdisciplinary research for occupational safety and health knowledge. *Policy and practice in health and safety*, 2016. 14(1): p. 22-33.
- [5] Kling, H.E., et al., Weight status and binge drinking among male and female Florida firefighters. *Journal of occupational and environmental medicine*, 2023. 65(8): p. e565-e570.
- [6] Rosner, D. and G. Markowitz, A short history of occupational safety and health in the United States. *American journal of public health*, 2020. 110(5): p. 622-628.
- [7] Montoya-Barthelemy, A., et al., Occupational and environmental hazards of correctional settings: a scoping literature review from acoem's presidential task force on correctional institutions. *Journal of Occupational and Environmental Medicine*, 2022. 64(3): p. e172-e182.
- [8] Dini, G., et al., Occupational Infections Among Workers in Europe: Protocol for a Scoping Review. *JMIR Research Protocols*, 2025. 14(1): p. e59606.
- [9] Baker, M.G., T.K. Peckham, and N.S. Seixas, Estimating the burden of United States workers exposed to infection or disease: a key factor in containing risk of COVID-19 infection. *PloS one*, 2020. 15(4): p. e0232452.
- [10] Holt, K.L., *Occupational Health in the Age of Climate Change: A Review of Emerging Challenges and Strategic Interventions*. *Contemporary Journal of Applied Sciences*, 2025. 3(5): p. 265-282.
- [11] Yokoyama, K. and S. Iijima, The socio-economic impact of occupational diseases and injuries. *Industrial health*, 2013. 51(5): p. 459.
- [12] Vonesch, N., et al., Emerging zoonotic viral infections of occupational health importance. *Pathog Dis*, 2019. 77(2).
- [13] Alamri, G.M., et al., Addressing antibiotic resistance through interdisciplinary collaboration between nursing and pharmacy. *International journal of health sciences*. 6(S10): p. 2144-2172.
- [14] Brämberg, E.B., et al., Development of evidence-based practice in occupational health services in Sweden: a 3-year follow-up of attitudes, barriers and facilitators. *Int Arch Occup Environ Health*, 2017. 90(4): p. 335-348.
- [15] Verbeek, J. and I. Ivanov, Essential Occupational Safety and Health Interventions for Low- and Middle-income Countries: An Overview of the Evidence. *Saf Health Work*, 2013. 4(2): p. 77-83.
- [16] Pößnecker, T., et al., Occupational physicians dealing with mental health: between employee and company interests: a qualitative study. *BMC Psychol*, 2022. 10(1): p. 306.
- [17] Simonin, Y., *Emerging Diseases/Viruses Prevention, Control, Surveillance, and One Health*. *Trop Med Infect Dis*, 2023. 8(5).
- [18] Khodayari-Zarnaq, R., G. Alizadeh, and G. Alizadeh, *Emerging and Re-emerging Diseases: Policies and Strategies for Future. Evidence Based Health Policy, Management and Economics*, 2020.
- [19] Organization, W.H., *Integrating the social determinants of health into health workforce education and training*. 2023: World Health Organization.
- [20] Mess, F., et al., Precision prevention in occupational health: a conceptual analysis and development of a unified understanding and an integrative framework. *Front Public Health*, 2024. 12: p. 1444521.
- [21] Janc, M., et al., Distribution of sleep components while working remotely. *Int J Occup Med Environ Health*, 2024. 37(1): p. 34-44.
- [22] Roelofs, C., et al., Occupational and environmental health equity and social justice. *Occupational and Environmental Health*, 2017: p. 23-39.
- [23] La Torre, G., et al., *Occupational medicine and prevention of chronic and infectious diseases*. 2023, MDPI. p. 5298.
- [24] Pattyn, N. and R. Hauffa, *Handbook of Mental Performance*. 2024: Taylor & Francis.
- [25] Dash, S.S., S. Panda, and N.R. Mohanty, Beyond the microscope: Microbial infections in occupational settings. *International Journal Of Advanced Academic Studies [Internet]*. 1: p. 25-8.
- [26] van der Molen, H.F. and M.H. Frings-Dresen, *Occupational diseases: from cure to prevention*. 2019, MDPI. p. 1681.
- [27] Safety, O. and H. Administration, *Identifying hazard control options: the hierarchy of controls*.

- [28] Kutscher, M., Development of an HTO-based framework for occupational health management in high-risk environments. *Transportation Research Procedia*, 2025. 88: p. 331-340.
- [29] Fisher, E., et al., Occupational safety and health equity impacts of artificial intelligence: a scoping review. *International journal of environmental research and public health*, 2023. 20(13): p. 6221.
- [30] Hamley, J.I., G. Beldi, and D. Sánchez-Taltavull, Infectious Disease in the Workplace: Quantifying Uncertainty in Transmission. *Bulletin of Mathematical Biology*, 2024. 86(3): p. 27.
- [31] Olson, R., et al., Total Worker Health® and Organizational Behavior Management: emerging opportunities for improving worker well-being. *Journal of Organizational Behavior Management*, 2023. 43(4): p. 280-319.
- [32] Brewer, S.E., et al., Rapid Community Translation in the Colorado CEAL (CO-CEAL) Program: transcreeing messaging to promote COVID-19 vaccination. *American Journal of Public Health*, 2024. 114(S1): p. S50-S54.
- [33] Mori, T., et al., Workplace social support and work engagement among Japanese workers: a nationwide cross-sectional study. *Journal of Occupational and Environmental Medicine*, 2023. 65(7): p. e514-e519.
- [34] Banks, C., et al., Scoping Total Worker Health: An Expanded View of Worker Well-being. *J Occup Environ Med*, 2025. 67(7): p. 558-563.
- [35] Caruso, D., et al., Preparing the Occupational Safety and Health Workforce for Future Disruptions. 2024.
- [36] Bodin, T., et al., Precarious employment in occupational health—an OMEGA-NET working group position paper. *Scandinavian journal of work, environment & health*, 2020. 46(3): p. 321-329.
- [37] Benach, J., et al., Precarious employment: understanding an emerging social determinant of health. *Annual review of public health*, 2014. 35(1): p. 229-253.
- [38] Muntaner, C., et al., A macro-level model of employment relations and health inequalities. *International Journal of Health Services*, 2010. 40(2): p. 215-221.
- [39] Wyatt, R., et al., Achieving health equity: a guide for health care organizations. IHI white paper. Cambridge, MA: Institute for Healthcare Improvement; 2016. 2016.
- [40] Curtin, M., H.L. Richards, and D.G. Fortune, Resilience among health care workers while working during a pandemic: A systematic review and meta synthesis of qualitative studies. *Clinical psychology review*, 2022. 95: p. 102173.
- [41] Check, P., et al., Health Equity and a Paradigm Shift in Occupational Safety and Health. 2022.
- [42] Braveman, P.A., et al., Health disparities and health equity: the issue is justice. *American journal of public health*, 2011. 101(S1): p. S149-S155.
- [43] Nielsen, K. and A. Noblet, Organizational interventions for health and well-being. *A Handbook for Evidence-based Practice*, 2018. 10.
- [44] Gabelloni, M., et al., Exploring radiologists' burnout in the COVID-19 era: a narrative review. *International Journal of Environmental Research and Public Health*, 2023. 20(4): p. 3350.
- [45] Franco, G. and F. Franco, Bernardino Ramazzini: The Father of Occupational Medicine. *Am J Public Health*, 2001. 91(9): p. 1382.
- [46] Carnevale, F., Chapter Bernardino Ramazzini e il suo De Morbis artificum diatriba. 2024.
- [47] Harrison, J. and L. Dawson, Occupational health: Meeting the challenges of the next 20 years. *Safety and health at work*, 2016. 7(2): p. 143-149.
- [48] McIvor, A., *Working lives: work in Britain since 1945*. 2013: Bloomsbury Publishing.
- [49] Brabant, D., Health and Safety Law from the Industrial Revolution to the New Zealand Health and Safety at Work Act 2015. *New Zealand Journal of Health and Safety Practice*, 2024. 1(2).
- [50] Soupene, V.A., et al., Circumstances contributing to installation, maintenance, and repair worker death by suicide. *Journal of occupational and environmental medicine*, 2023. 65(5): p. 394-400.
- [51] Tawde, P.P., et al., Alice Hamilton: A Legacy of Advancing Occupational Health and Safety Standards. *Cureus*, 2024. 16(9).
- [52] Gunawan, R., et al., EFEKTIFITAS PENGGUNAAN BAHASA PADA INSTRUKSI KESELAMATAN DI KONSTRUKSI TWIN TOWER UPN" VETERAN" JAWA TIMUR. *Jurnal Membaca Bahasa dan Sastra Indonesia*, 2024. 9(1).
- [53] Ferdohleb, A., Changes in occupational profiles and occupational health service. *Anthropological Researches and Studies*, 2018(8): p. 178-188.

- [54] Corradi, M. and S. Ranzieri, COVID-19 Marked a Change in the Scope of Occupational Medicine from Occupational to Work-Related Diseases and Total Worker Health®. *La Medicina del lavoro*, 2023. 114(6): p. e2023053.
- [55] Tan, A., W.H. Gan, and D. Koh, The COVID-19 pandemic and occupational health—transitioning to the new normal. 2024, Oxford University Press UK. p. kqae082.
- [56] Brown, C.E., et al., Integration of Total Worker Health® Training for Occupational Health and Safety Professionals With Efforts to Promote Worker Health, Safety, and Well-being in Mexico. *Journal of Occupational and Environmental Medicine*, 2024. 66(5): p. 388-394.
- [57] de Fátima Neves, M., et al., Evolução histórica da segurança e medicina do trabalho, saúde ocupacional e saúde do trabalhador. *REVISTA DELOS*, 2024. 17(60): p. e2055-e2055.
- [58] Sharma, N., et al., Prevalence and Technology Advancements at Work Place to Enhance Occupational Health and Safety of Employees, in *Challenges and Opportunities for Innovation in India*. 2025, CRC Press. p. 29-35.
- [59] Smith, L.L., et al., Healthcare personnel interactive pathogen exposure response system. *Infection Control & Hospital Epidemiology*, 2023. 44(8): p. 1358-1360.
- [60] Brown-Johnson, C., et al., Qualitative interview study of strategies to support healthcare personnel mental health through an occupational health lens. *BMJ open*, 2024. 14(1): p. e075920.
- [61] Guidotti, T.L., Occupational health is global, too. 2019, Taylor & Francis. p. 295-296.
- [62] Bee, T.K., The Future Dynamics of the Chemical Distribution Business in the ASEAN with the Anticipated Surge of M&A. *The Journal of Private Equity*, 2019. 23(1): p. 110-123.
- [63] Sehgal, N.J. and D.K. Milton, Applying the hierarchy of controls: what occupational safety can teach us about safely navigating the next phase of the global COVID-19 pandemic. *Frontiers in public health*, 2021. 9: p. 747894.
- [64] Freni-Sterrantino, A. and V. Salerno, A plea for the need to investigate the health effects of gig-economy. *Frontiers in public health*, 2021. 9: p. 638767.
- [65] Peters, S.E., et al., Work and worker health in the post-pandemic world: a public health perspective. *The Lancet Public Health*, 2022. 7(2): p. e188-e194.
- [66] Mathur, N., Socioeconomic Vulnerabilities of Migrant Labour Households in Delhi. *Indian Public Policy Review*, 2024. 5(4 (Jul-Aug)): p. 1-18.
- [67] Matsuura, H., Gender mainstreaming in occupational health and safety: Challenges in the era of the Sustainable Development Goals, in *Gender and the Sustainable Development Goals*. 2022, Routledge. p. 46-60.
- [68] Durando, P., et al., Learning from the Experience of the COVID-19 Pandemic: A New Paradigm for Occupational Biohazard Assessment and Management. *La Medicina del Lavoro*, 2023. 114(6): p. e2023056.
- [69] Vasudevan, S.S., et al., Nanoparticle-based vaccines and future vaccine technologies, in *Advanced Vaccination Technologies for Infectious and Chronic Diseases*. 2024, Elsevier. p. 477-495.
- [70] Fiegler-Rudol, J., et al., Exploring Human-AI Dynamics in Enhancing Workplace Safety and Health: A Narrative Review. 2025.
- [71] Brass, S.D., et al., Artificial Intelligence in Healthcare: The Revolutionization of Medicine. *Physician Leadership Journal*, 2024. 11(3).
- [72] Fefferman, N.H., et al., A new paradigm for pandemic preparedness. *Current epidemiology reports*, 2023. 10(4): p. 240-251.
- [73] Enos, G., Reports show pressure on workplaces to deliver MH support. *Mental Health Weekly*, 2024. 34(47): p. 5-5.
- [74] Veltri, A., F. Caldi, and R. Buselli, Mental health and rapid societal evolution: an occupational prevention challenge. 2024, Oxford University Press UK. p. kqae130.
- [75] Deady, M., et al., A mentally healthy framework to guide employers and policy makers. *Frontiers in public health*, 2024. 12: p. 1430540.
- [76] Kirsten, W., The evolution from occupational health to healthy workplaces. *American Journal of Lifestyle Medicine*, 2024. 18(1): p. 64-74.
- [77] Streit, J.M., et al., Preparing the occupational safety and health workforce for future disruptions. *American journal of industrial medicine*, 2024. 67(1): p. 55-72.
- [78] Benson, C., et al., The impact of interventions on health, safety and environment in the process industry. *Heliyon*, 2024. 10(1).

- [79] Kerk, Y.W., et al. *A New Transmission Cause and Effect Analysis (TCEA) Approach to Risk Management for Non-Healthcare Context: A Case Study on COVID-19*. in *2024 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*. 2024. IEEE.
- [80] McLellan, R.K. and T.L. Guidotti, *Occupational and environmental medicine: an asset in time of crisis*, in *Ciottoni's Disaster Medicine*. 2024, Elsevier. p. 198-205.
- [81] Patrick, A. and R. Pryor, *COVID-19, burnout, and healthcare-associated infections: a focus on wellness as a top safety priority*. *Antimicrobial Stewardship & Healthcare Epidemiology*, 2023. 3(1): p. e155.
- [82] Luengas, E.V.L., *Immunization and innovation: the role of vaccination in reducing the threat of emerging infectious diseases*. *Premier J Public Health*, 2024.
- [83] Boles, C., et al., *Current understanding and future directions for an occupational infectious disease standard*. *Toxicology and Industrial Health*, 2020. 36(9): p. 703-710.
- [84] Zelenka Martin, A., et al., *A scoping review of behavioural science approaches and frameworks for health protection and emergency response*. *Perspectives in Public Health*, 2023: p. 17579139241257102.
- [85] Paganelli, M., et al., *Education and training in global occupational health and safety: a perspective on new pathways to sustainable development*. *Annals of Global Health*, 2018. 84(3): p. 538.
- [86] Trivedi, P. and F. Alqahtani, *The advancement of Artificial Intelligence (AI) in Occupational Health and Safety (OHS) across high-risk industries*. *J. Infrastruct. Policy Dev*, 2024. 8: p. 6889.
- [87] Hegelund, M.H., D. Faurholt-Jepsen, and I.C. Bygbjerg, *Prevention of opportunistic non-communicable diseases*. *International health*, 2020. 12(1): p. 1-2.
- [88] Higgins, I.T., *Epidemiology in occupational health policy*, in *Epidemiology and Health Policy*. 2022, Routledge. p. 157-176.
- [89] Godderis, L., et al., *Lessons learned from the COVID-19 pandemic—what occupational safety and health can bring to public health*. *Journal of Public Health Policy*, 2023. 44(1): p. 138-146.
- [90] Hager, K.M., B. Linde, and C.A. Redlich, *Occupational Disease in the 21st Century: COVID-19, Climate Change, and the Fourth Industrial Revolution*, in *Modern occupational diseases: Diagnosis, epidemiology, management and prevention*. 2022, Bentham Science Publishers. p. 1-24.
- [91] Guerin, R.J., et al., *Dissemination and Implementation Research in the Workplace*. 2023.
- [92] Vainio, H., *Editorial Occupational safety and health in the service of people*. *Industrial health*, 2015. 53(5): p. 387-389.
- [93] Woods, E.H., et al., *Addressing psychosocial, organizational, and environmental stressors emerging from the COVID-19 pandemic and their effect on essential workers' mental health and well-being: a literature review*. *Journal of occupational and environmental medicine*, 2023. 65(5): p. 419-427.
- [94] Apostolopoulos, Y., et al., *The indispensable whole of work and population health: How the working life exposome can advance empirical research, policy, and action*. *Scandinavian Journal of Work, Environment & Health*, 2024. 50(2): p. 83.
- [95] Khoe, L.C., et al., *Global trends in occupational disease reporting: a systematic review*. *medRxiv*, 2024: p. 2024.09.19.24314032.
- [96] Chen, P.H., et al., *Medical accessibility and underreporting of occupational diseases: effect of travel distance and travel time*. *Frontiers in rehabilitation sciences*, 2025. 6: p. 1545460.
- [97] Quintero Santofimio, V., A.F. Amaral, and J. Feary, *Occupational exposures in low-and middle-income countries: A scoping review*. *PLOS Global Public Health*, 2024. 4(11): p. e0003888.
- [98] Zheng, S., et al., *The occupational medicine pipeline: report on the results of a survey of International Occupational Medicine Society Collaborative (IOMSC) member countries*. *Journal of occupational and environmental medicine*, 2022. 64(3): p. e165-e171.
- [99] Teodoro, M. and F. Giambò, *Well-Being and Safety in the Workplace*. *International Journal of Environmental Research and Public Health*, 2022. 19(14): p. 8712.
- [100] Viel, J.-F., N. Bonvallot, and W. Dab, *Integration of occupational exposure into the exposome*, in *Handbook of life course occupational health*. 2023, Springer. p. 1-16.
- [101] Tsai, S.-Y., et al., *Sleep and its disturbance in parents of children and adolescents with epilepsy: A systematic review and meta-analysis*. *Nature and Science of Sleep*, 2023: p. 1139-1152.
- [102] Bolghanabadi, S., A. Haghighi, and M. Jahangiri, *Insights into women's occupational health and safety: A decade in review of primary data studies*. *Safety*, 2024. 10(2): p. 47.
- [103] Rosemberg, M.-A.S., D.M. Boutain, and J. Hsin-Chun Tsai, *Occupational health research beyond the work setting: Inclusive inquiry with ethnic minority and immigrant workers*. *Ethnicity & Health*, 2021. 26(8): p. 1242-1260.

- [104] Sallinen, M., *Digital Occupational Health: Opportunities and Challenges for the Workplace*. *Journal of UOEH*, 2024. 46(1): p. 87-92.
- [105] Westerholm, P., *The ethical challenges of the occupational physician in our time*. *Giornale italiano di medicina del lavoro ed ergonomia*, 2010. 32(4): p. 403-406.
- [106] Negrei, C., A. VLASCEANU, and D.L. Baconi, *EXPOSOME RESEARCH: DEFINITION, SCOPE AND THE NEED FOR MULTIDISCIPLINARY RESEARCH*. *Farmacia*, 2023. 71(4).
- [107] Sandys, V., et al., *Managing SARS-CoV-2 transmission risk in workplace COVID-19 outbreaks*. *Annals of Work Exposures and Health*, 2024. 68(9): p. 982-991.
- [108] Courtice, M.N., A.C. Olsson, and J.W. Cherrie, *Less Economically developed countries need help to create healthy workplaces*. *Frontiers in Public Health*, 2019. 7: p. 257.
- [109] Baillargeon, M., et al., *Occupational medicine, witness to social evolution*. *Revue Medicale Suisse*, 2022. 18(788): p. 1291-1294.
- [110] Carnevale, F. and S. Iavicoli, *Bernardino Ramazzini (1633–1714): a visionary physician, scientist and communicator*. 2015, BMJ Publishing Group Ltd. p. 2-3.
- [111] HOwArd, J. and F. HeArl, *Occupational Safety and Health in the USA: Now and the Future*. *Industrial health*, 2012. 50(2): p. 80-83.
- [112] Busyedin, V., *Understanding the Intersection of Occupational Health and Infectious Diseases: Addressing Underexplored Risks in High-Risk Work Environments*. *International Journal Papier Public Review*, 2024. 5(1): p. 1-9.
- [113] Peters, S., et al., *Narrative review of occupational exposures and noncommunicable diseases*. *Annals of Work Exposures and Health*, 2024. 68(6): p. 562-580.
- [114] Mehlum, I.S. and M.C. Turner, *Challenges of large cohort and massive data in occupational health*, in *Handbook of Life Course Occupational Health*. 2023, Springer. p. 1-26.
- [115] Sakai, K., et al., *Research topics in occupational medicine, 1990–2022: A text-mining-applied bibliometric study*. *Scandinavian journal of work, environment & health*, 2024. 50(7): p. 567.
- [116] Momeni, Z., et al., *Work-related musculoskeletal symptoms among agricultural workers: a cross-sectional study in Iran*. *Journal of agromedicine*, 2020. 25(3): p. 339-348.
- [117] Mosadeghrad, A.M., et al., *Joint comprehensive plan of action for occupational health*. *Journal of Health and Safety at Work*, 2024.
- [118] Workman, B., et al., *Implementation of an Awareness Level Training to Prepare the Workforce for Future Infectious Disease Outbreaks*. *Disaster Medicine and Public Health Preparedness*, 2024. 18: p. e9.
- [119] Shan, Y. and M. Ji, *Cultural Relevance of Mental Health Scales*, in *Cultural Adaptation in Chinese Mental Health Translation*. 2024, Springer. p. 27-31.
- [120] Masood, M.A., et al., *Occupational health in the Gulf Cooperation Council (GCC): A systematic review and call for comprehensive policy development*. *Plos one*, 2024. 19(12): p. e0312251.
- [121] Lindholm, M., A. Reiman, and S. Tappura, *The evolution of new and emerging occupational health and safety risks: A qualitative review*. *Work*, 2024. 79(2): p. 503-521.
- [122] Dothard, T., et al., *Showcasing Environmental Health and Safety Activities During the Coronavirus Disease 2019 Pandemic*. *Applied Biosafety*, 2023. 28(1): p. 22-31.
- [123] Aitbekov, K., et al., *Impact of High-Touch Surfaces on Potential Transmission of Diseases in Offices and Public Buildings*, in *Resilience vs Pandemics: Innovations in Public Places and Buildings*. 2024, Springer. p. 123-136.
- [124] Adisesh, A. and C.J. Baker, *Occupational Health Informatics*. 2023, Oxford University Press UK. p. 177-180.
- [125] Pan, C.-C., M. Urban, and B. Schüz, *Unintended consequences of digital behavior change interventions: A social–ecological perspective*. *European Journal of Health Psychology*, 2024.
- [126] Holness, D., A. Thompson, and G. Liss, *The Ontario Workplace Health Champions Program*. *Occupational Medicine*, 2024. 74(2): p. 142-145.
- [127] Ropponen, A., R. Rugulies, and A. Burdorf, *Towards the year 2049: The next 25 years of occupational health and safety research*. *Scandinavian Journal of Work, Environment & Health*, 2024. 50(8): p. 581.
- [128] Diez Roux, A.V., *The unique space of epidemiology: drawing on the past to project into the future*. *American journal of epidemiology*, 2019. 188(5): p. 886-889.
- [129] Granger, S. and N. Turner, *Adapting, adopting, and advancing change: A framework for future research in the psychology of occupational safety*. *Journal of safety research*, 2022. 82: p. 38-47.

- [130] Grandi, C., A. Lancia, and M.C. D'Ovidio, *Climate change: an issue that should be part of workers' information and training duties envisaged by EU directives on occupational health and safety. Atmosphere*, 2023. 14(7): p. 1183.
- [131] Bradshaw, S.E., *Life's work: occupational health—the wealth of the nation. The British Journal of General Practice*, 2008. 58(554): p. 605.
- [132] Fleming, H.-K., *Navigating workplace wellness programs in the age of technology and big data. Journal of Science Policy & Governance*, 2020. 17(1).
- [133] Gbaje, P.J. and H.F. Abubakar, *Technical solutions for resolving workplace challenges. Journal of Professional Secretaries and Office Administrators*, 2022. 29(1): p. 116-120.
- [134] Pham, C.T., et al., *Integrative settings approach to workplace health promotion to address contemporary challenges for worker health in the Asia-Pacific. Global Health Promotion*, 2020. 27(2): p. 82-90.
- [135] Fanning, P., *Mental Health Becomes Key to Welfare*. 2024, MA Business London.
- [136] Fujishiro, K., E.Q. Ahonen, and M. Winkler, *Investigating employment quality for population health and health equity: a perspective of power. International Journal of Environmental Research and Public Health*, 2022. 19(16): p. 9991.
- [137] Ahonen, E.Q., M.R. Winkler, and A. Hajat, *Work, health, and the ongoing pursuit of health equity*. 2022, MDPI. p. 14047.
- [138] Syamila, A.I., et al., *Journal of Vocational Health Studies. Journal of Vocational Health Studies*, 2024. 8: p. 56-67.
- [139] MacGillivray, S., *Reviewing the Literature, in Knowledge, Innovation, and Impact: A Guide for the Engaged Health Researcher*. 2021, Springer. p. 165-174.
- [140] Johnson, C.Y. and K. Fujishiro, *Identifying occupational health inequities in the absence of suitable data: are there inequities in access to adequate bathrooms in US workplaces? Occupational and environmental medicine*, 2023. 80(10): p. 572-579.
- [141] Gudi-Mindermann, H., et al., *Integrating the social environment with an equity perspective into the exposome paradigm: a new conceptual framework of the Social Exposome. Environmental research*, 2023. 233: p. 116485.
- [142] Box-Steffensmeier, J.M., et al., *The future of human behaviour research. Nature Human Behaviour*, 2022. 6(1): p. 15-24.
- [143] Bibi, E., et al., *Understanding the Concept of Health Inequality, in Health Inequality-A Comprehensive Exploration*. 2023, IntechOpen.
- [144] Modula, M.J., et al., *Strategies for coping with occupational trauma: a scoping review of the police officer context. International journal of environmental research and public health*, 2024. 21(7): p. 921.
- [145] Peckham, T.K., et al., *Creating a future for occupational health. Annals of Work Exposures and Health*, 2017. 61(1): p. 3-15.