The OCCHLTH Mnemonic—Construction and Content of a Tool for Increasing Awareness of Occupational Illness and Injury

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Introduction: Unidentified or nonmitigated occupational illnesses and injuries can complicate disease management. The "occupational health" (OCCHLTH) mnemonic aims to raise awareness of work-related exposures and associated illnesses and injuries. **Methods:** Occupational safety and health history-taking elements were combined with peer-reviewed information [from the PubMed database (first review January 1, 2000, to February 8, 2016; updated to February 8, 2021)] about workplace exposure-outcome associations to create the mnemonic. **Results:** Seven components constitute the OCCHLTH mnemonic. Literature results support its categories and subcategories. Three components represent symptom onset and health conditions. Four represent occupational exposures. Evaluating published occupational illness cases explored mnemonic applicability. **Conclusions:** Awareness of occupational risk factors can affect clinical decision-making. The OCCHLTH mnemonic encourages consideration of occupational causes of illness and injury to optimize patient care. Further evaluation of the utility of the OCCHLTH mnemonic is needed.

Keywords: diagnosis of occupational illness and injury, medical education, occupational health, primary care, workforce

LEARNING OUTCOMES

- Understand the basis for and the elements of the OCCHLTH mnemonic as a tool for raising awareness of occupational illness and injury.
- Create the basis for recalling OCCHLTH elements of workplace exposures and health outcomes relevant to occupational illness and injury for use in clinical contexts and as a life-long learning device.

Occupational illnesses and injuries are underdiagnosed[1–3] for several reasons. They can have nonspecific presentations or long latency periods.[4–7] Clinical suspicion or knowledge may be limited about the workplace exposures.[4–7] Health effects can result from direct workplace exposure, such as from chemicals or physical agents (eg, noise), or from exposure to other affected workers, such as infectious diseases.[2] Identifying occupational exposure-outcome associations in one person might suggest a need to evaluate others in that same work setting, increasing the chance of identifying work-related factors needing mitigation.[8] While occupational medicine (OM) training does occur in some non-OM residencies,[9] general occupational illness and injury detection has not necessarily improved.[10,11] Increased recognition of potential occupational injuries and illnesses could result in appropriate treatment, specialty referral, and preventive efforts, and decreased illness and injury burden for workers.

Formal OM evaluations can be lengthy, result in time pressure for non-OM clinicians, and require knowledge of job task-exposure and occupational exposure-outcome associations.[12] Some evaluation tools can target outcomes, eg, occupational asthma,[13] be self-reported,[14] or assess chemical/nonchemical exposures and specific organ systems, such as pulmonary and dermal.[15] Memory aids may improve recall by grouping information,[16,17] possibly decreasing information handled by working memory, increasing recall, and enhancing learning and clinical activities.[18] For example, SAMPLE (S: signs/symptoms; A: allergies; M: medications; P: past medical/surgical history; L: last oral intake; and E: triggering/important events before the illness or injury) is used to recall history information to elicit in an emergency.[19] The CAGE questions ([1] have you ever felt you should "C"ut down on your drinking; [2] have people "A"nnoyed you by criticizing your drinking; [3] have you ever felt bad or "G"uilty about your drinking; and [4] have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover ["E"ye opener])[20] help examine potential alcohol dependence and need to evaluate alcohol use.

The "occupational health" (OCCHLTH) mnemonic was created as a memory aid to prompt health care providers to think about, organize information on, and increase awareness of occupational etiologies, in a shorthand form for better recall. The mnemonic's seven elements include exposure and outcome categories and subcategories relevant for various occupational contexts. The OCC portion categorizes onset timeframe and musculoskeletal and key conditions. The HLTH portion categorizes occupational exposures associated with these outcomes. While not a diagnostic or formal screening tool, it can enhance appreciation of and appropriately heighten suspicion for occupational etiologies to inform clinical decision making and management. This paper describes the OCCHLTH mnemonic construction and content and explores its application using published cases.

METHODS

Construction of the OCCHLTH Mnemonic

The author created the mnemonic using a seven element memory aid format that is considered optimal for memory aid devices.[16,17] Occupational health history tool components,[12–15] hazard identification and clinical examination principles,[12] subject matter expert (SME) input, and published exposure-outcome information contributed to the mnemonic. Different configurations were considered (not presented).

Information Sources for the Literature Search Strategy and the OCCHLTH Mnemonic Elements

Health History Tools

Occupational health history-taking principles by Guidotti and others[12,15] provided core terms on exposures and outcomes/body systems, including pulmonary and dermal disease specific terms, for the literature search strategy and mnemonic structure. A general, self-report, occupational health history-taking tool,[14] one tool for occupational asthma,[13] and terms on musculoskeletal disorders (MSDs), a major class of occupational health effect,[15] provided additional information. Exposure

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and associated outcome terms beyond those for chemical, biological, radiological, nuclear-dust, particulate matter (CBRN-DP), and physical exposures were from the Standard Shiftwork Index.[21]

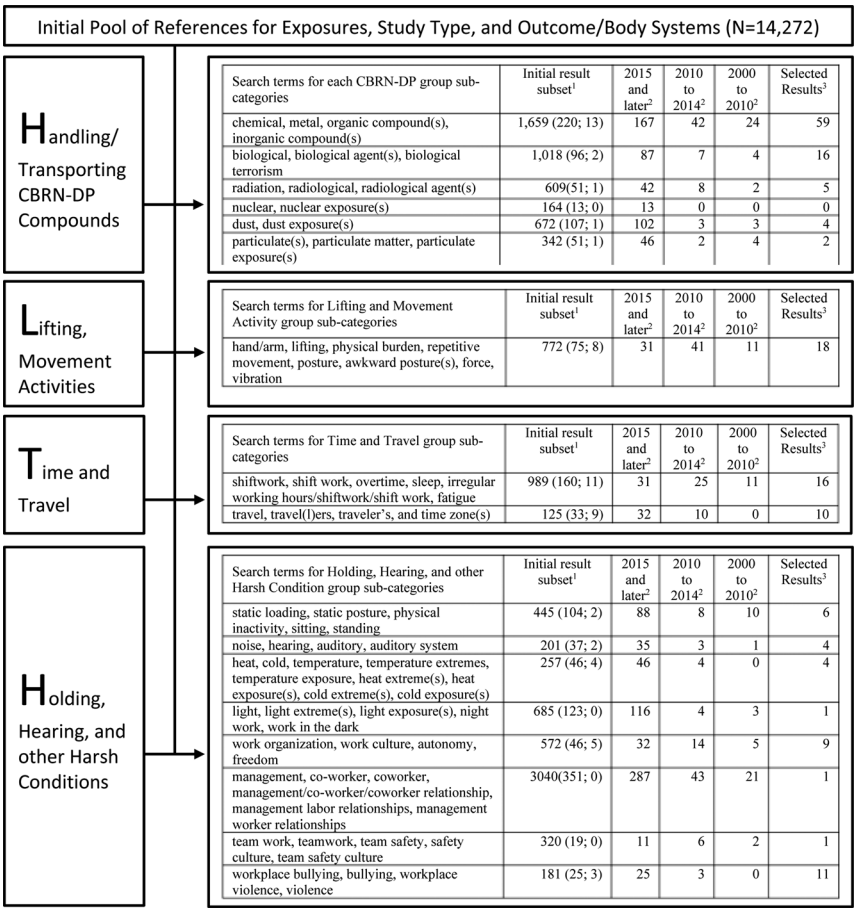
Subject Matter Expert Input

Circulating the above list to SMEs at the National Institute for Occupational Safety and Health (NIOSH) for input added other terms for individual CBRN-DP agents, endocrine effects, work travel, autonomy, teamwork, management/labor relationships, and workplace bullying and violence. The SMEs reviewed this list, provided input on terms related to categories and subcategories to better capture information relevant to the occupational setting, and reviewed portions of the list more than once as it was being developed to drive the literature search strategy and the structure of the mnemonic.

Literature Search

Figure 1 presents the literature search flow, by HLTH element terms and by subcategories. This does not mean that only exposure category terms were used in the search. The goal of this search was different from one where a specific exposure, outcome, or exposure-outcome association might be the focus. In this search, terms were used to obtain evidence on a range of relevant exposure-outcome associations. This strategy did not produce an exhaustive OSH literature database, which is outside this publication's scope. This work had a different purpose than literature search activities that focus on a defined clinical or scientific question and where having such a defined question is essential to meet criteria for listing in a formal literature search registry. Thus, it was not appropriate to list this work in such a registry.

Using the list of terms described above, with PubMed Medical Subject Heading terms for occupational illness and injury/health/safety/disease, exposures, outcomes/body systems, and study design types added, the PubMed database was searched in an initial literature review from January 1, 2000, to February 8, 2016, which was updated through to December 18, 2023, for English-language, systematic reviews and meta-analyses on human data. Overall, the initial and extended searches supported the mnemonic structure. Because the goal of the search was to support the mnemonic structure and not develop an exhaustive body of information on occupational safety and health, the search as conducted is a reasonable basis for the mnemonic. PubMed was used as it indexes several primary OSH journals. If scientific evidence has matured to the point that systematic reviews or meta-analyses are appropriate to conduct, such publications would likely be found in the primary OSH journals indexed in PubMed. Thus, other databases were not examined in this search. Publications on standard-of-care recommendations or guidance appeared in this



Search terms for each CBRN-DP group sub-categories	Initial result subset[1]	2015 and later[2]	2010 to 2014[2]	2000 to 2010[2]	Selected Results[3]
chemical, metal, organic compound(s), inorganic compound(s)	1,659 (220; 13)	167	42	24	59
biological, biological agent(s), biological terrorism	1,018 (96; 2)	87	7	4	16
radiation, radiological, radiological agent(s)	609(51; 1)	42	8	2	5
nuclear, nuclear exposure(s)	164 (13; 0)	13	0	0	0
dust, dust exposure(s)	672 (107; 1)	102	3	3	4
particulate(s), particulate matter, particulate exposure(s)	342 (51; 1)	46	2	4	2

Search terms for Lifting and Movement Activity group sub-categories	Initial result subset[1]	2015 and later[2]	2010 to 2014[2]	2000 to 2010[2]	Selected Results[3]
hand/arm, lifting, physical burden, repetitive movement, posture, awkward posture(s), force, vibration	772 (75; 8)	31	41	11	18

Search terms for Time and Travel group sub-categories	Initial result subset[1]	2015 and later[2]	2010 to 2014[2]	2000 to 2010[2]	Selected Results[3]
shiftwork, shift work, overtime, sleep, irregular working hours/shiftwork/shift work, fatigue	989 (160; 11)	31	25	11	16
travel, travel(l)ers, traveler's, and time zone(s)	125 (33; 9)	32	10	0	10

Search terms for Holding, Hearing, and other Harsh Condition group sub-categories	Initial result subset[1]	2015 and later[2]	2010 to 2014[2]	2000 to 2010[2]	Selected Results[3]
static loading, static posture, physical inactivity, sitting, standing	445 (104; 2)	88	8	10	6
noise, hearing, auditory, auditory system	201 (37; 2)	35	3	1	4
heat, cold, temperature, temperature extremes, temperature exposure, heat extreme(s), heat exposure(s), cold extreme(s), cold exposure(s)	257 (46; 4)	46	4	0	4
light, light extreme(s), light exposure(s), night work, work in the dark	685 (123; 0)	116	4	3	1
work organization, work culture, autonomy, freedom	572 (46; 5)	32	14	5	9
management, co-worker, coworker, management/co-worker/coworker relationship, management labor relationships, management worker relationships	3040(351; 0)	287	43	21	1
team work, teamwork, team safety, safety culture, team safety culture	320 (19; 0)	11	6	2	1
workplace bullying, bullying, workplace violence, violence	181 (25; 3)	25	3	0	11

FIG. 1. Literature search strategy to identify occupational exposure-outcome associations to support the OCCHLTH mnemonic. Results are organized by HLTH categories and subcategories. 1. Number from subcategory searches of first pool of 14,272 results. In parenthesis are those (1) retained after excluding duplicates, experimental studies, and studies on pediatric populations, pharmaceutical treatments, surgical interventions, implantable/prosthetic devices, and unpaid work/workers and (2) obtained from key publications' reference list reviews and targeted/hand searches. 2. Listing of publications by year-based timeframes. 3. Publications meeting inclusion criteria described in methods comprise the selected results. CBRN-DP, chemical, biological, radiological, nuclear, dust, and particulate matter.

approach. The search focused on the two most recent decades of US national census timeframes (2000 and 2010) to capture different types of information. One type of information was up-to-date, focused reviews, such as for neck-shoulder disorders, instead of general MSDs. Another was reviews for newer hazards, compared to those that have been known since before 2000. Another was from 2015 and later, to focus on more recent literature.

The phrase "NOT environment" was applied to initial pools of search results because PubMed algorithms include environmental safety and health results in searches even when environmental terms are not specified. While some occupational studies may be excluded, this avoids prohibitively excessive results, in some cases in the hundreds of thousands. Searching for specific health effects requires many terms. Body system terms capture a range of health effects, ie, searching by "hypertension" and "stroke" identifies studies on these outcomes, but searching by "cardiovascular disease," or "cardiovascular," returns results for these diseases and others like coronary syndromes or myocardial infarction. Search statement information can be provided by the author upon request.

The search found a base pool of 14,272 results. This base pool was constructed by first conducting searches using terms for the following four categories [results in brackets], and restricting to publications after January 1, 2000, (1) occupational illness and injury/health/safety/disease [251,951 results]; (2) exposures [5,458,156 results]; (3) study design types [2,843,210]; and (4) organ/body systems [10,662,798]. The four category results were combined using the "AND" Boolean operator, producing a pool of 15,730 results. Restricting to human, English language studies produced the pool of 14,272 results used in subsequent searches using subcategory terms to examine literature supporting mnemonic elements.

The base pool of literature was then searched using different subcategory terms (listed in Fig. 1). For example, for CBRN-DP subcategories were individually used to search the base pool using the Boolean operator AND, to produce initial result subsets for CBRN-DP subcategories. Titles and abstracts of subcategory results were examined, excluding studies on pediatric populations, pharmaceutical treatments, surgical interventions, and implantable/prosthetic devices. Studies on unpaid work/workers were excluded because methodological issues (unreliable ascertainment, risk factor definition variability, inconsistent exposure assessment methods, and outcome definition misclassification) were too disparate across studies to be consistently interpreted. Genetic, molecular, and cellular mechanisms of disease studies in animal or in vitro models were excluded unless deemed critical to support exposure-outcome associations. Reference lists were examined to identify seminal publications important to consider and topics for targeted/hand searches in PubMed.

Retained publications from the initial subset, after exclusions were applied, were portioned into three date groups: 01/01/2015 and later, 01/01/2010 to 12/31/2014, and 12/31/2009 and earlier to assist with decisions regarding selection of publications when several studies had been reported using a single data source or other decisions based on historical publications for a subcategory. These results were checked again to remove duplicates. Title and abstract screening were used to retain systematic reviews, meta-analyses, meta-regression studies, key narrative reviews, select individual studies (eg, cohort, case-control, etc), and guidance/recommendation publications of exposure-outcome associations (Fig. 1). Title, abstract, authors, journal (issue, volume, pages), year, and study design for these publications were abstracted into an Excel spreadsheet (Microsoft Excel, 2021). Publications included in the "selected results" column of Figure 1 were the most recent or most broadly representative systematic review or meta-analyses or were the latest and/or most representative reviews, for a given exposure-outcome association or data source. When appropriate, selected results included narrative reviews or other guidance and recommendation sources in lieu of an enumerated list of reviews on specific associations.

Literature-Quality Grading

Systematic reviews and meta-analyses often evaluate literature supporting formal screening/prevention strategies, diagnostic modalities, and intervention guidelines, with many literature-quality grading scales are anchored to the randomized clinical trial (RCT), considered an optimal study type in such reviews. The RCT, however, is not commonly used for establishing OSH associations. The Critical Skills Appraisal Programme (CASP) approach to systematic review and meta-analysis grading[22] is not anchored to the RCT and was used to evaluate the selected results. The CASP is not specifically designed to assess meta-regression studies; however, it is reasonable for this use and was thus applied.

Identification of Cases to Assess Applicability of the OCCHLTH Mnemonic

Cases were identified by searching the PubMed database using the search string of [[case report] OR [case series]] and [occupation], from January 1, 2000, to February 10, 2023, with 12,413 results. Unstructured searches were conducted for publications related to respiratory diseases or shiftwork in which a patient presented to a general clinic initially and then was found to have an occupational etiology and where enough detail was reported to be suitable for assessing the applicability of the mnemonic.

RESULTS

Overview of the OCCHLTH Mnemonic

The OCCHLTH mnemonic has seven elements representing occupational exposure and outcome information important to consider when evaluating a clinical situation. The OCC part represents information about health conditions (Table 1): "O" is for onset; "C" is for mus"-C"uloskeletal conditions; and the second "C" is for other key "C"onditions. The HLTH part represents information on exposures (Table 1): "H" is for the handling of, transporting of, or exposure to chemical, biological, radiological, nuclear, dust, or particulate compounds; "L" is for lifting or other ergonomic exposures; "T" is for time and travel, relating to shift work or other work hours issues and travel for work; the second "H" is for holding in awkward postures, hearing and other sensory exposures (light/dark, temperature extremes), and other harsh conditions such as workplace psychosocial stressors and workplace bullying/violence. The specific letters of OCCHLTH were chosen for the mnemonic after considering multiple other letter configurations, previous health history tool, SME input, and literature search result information. In this configuration, information categories and subcategories could be related best to each letter to facilitate use as an organizational and memory aid. In this process, the letters OCC seemed most appropriate as cues for onset and conditions, and the letters HLTH most appropriate as cues for exposures.

Of the final pool of 167 references supporting the OCCHLTH element, 107 were systematic reviews or meta-analysis/meta-regression studies (Fig. 1). The remaining studies and sources were general or narrative reviews, guidelines or other policy statements, or other types of studies that were included because of their seminal importance for an exposure-outcome association. Literature quality grading of the 107 systematic reviews or meta-analyses/meta-regression publications are found in Tables 2 and 3. These results illustrate that a majority of the systematic reviews and meta-analyses/meta-regression studies used to support the OCCHLTH elements are of excellent quality. Table 4 presents exposure/outcome associations for specific body system and HLTH categories that were found in the literature search results. These associations reinforce the mnemonic structure and provide an extensive catalog of examples of occupational exposures and health effects. A more detailed review of the evidence from the literature search is found after this overview as a deeper treatment of the basis for the mnemonic.

TABLE 1. Components of the OCCHLTH Mnemonic

Part I – Health Effects	
O	**"O"nset and/or duration of diagnosis or symptoms** **• New onset in the past week, in the past 1 wk to 1 mo, 1 to 6 mo, 6 mo to 1 yr ago** **• Present for longer than 1 yr** **• Has patient seen a doctor, or been diagnosed by a doctor, for this problem?** **• Has patient been told that this is work related? By whom?** **• Do symptoms/problems change (get worse, stay the same, or get better) when at work versus away from work (outside of work shift or workday, on weekends, on holidays)**
C	**Presence of mus"C"uloskeletal diagnosis or symptoms**
C	**Presence of key "C"onditions, whether diagnosis or symptoms, of importance in the occupational setting, by organ or physiologic system. Specific conditions listed are major diseases of interest, based on epidemiologic data, but are not meant to be an exhaustive listing.** **• Dermal – dermatitis, skin cancer** **• Cardiovascular/peripheral vascular – heart rate changes/irregularities, hypertension, myocardial infarction, cerebrovascular accident, Raynaud's phenomenon, hand-arm vibration syndrome (vibration-induced white finger)** **• Pulmonary – breathing problems, rhinitis, sinusitis, chronic cough, asthma, lung cancer, chronic bronchitis, emphysema, chronic obstructive pulmonary disease, pneumoconioses/hypersensitivity pneumonitis, dust diseases of the lung (silicosis, asbestosis, brown lung disease, black lung disease)** **• Renal – changes in urination, urine character, renal/bladder disease; renal/bladder cancer** **• Gastrointestinal/hepatic – altered liver or gastrointestinal function; liver, stomach, colon cancer** **• Endocrine/reproductive – testicular cancer, breast cancer, ovarian cancer, uterine cancer, prostate cancer, diabetes, thyroid disease, pregnancy** **• Hematologic – easy bruising, anemia** **• Neuro/psychiatric – hearing loss/any trouble hearing, other sensory problems, neuropathy, depression, stress, other neurological/psychiatric problems** **• Metabolic/infectious disease –nutritional deficit or status change; blood borne pathogens, infectious agent exposure in work environment or due to work travel**
Part II – Occupational Exposures	
• For exposure classes or types that may seem important in relationship to the presenting symptoms or diagnosis, further follow-up could establish how long the individual has been working in their current job/work/tasks or has been having exposure to suspected hazards in relation to the start of symptoms	
H	**"H"andle/transport of and/or exposure to CBRN-DP or do foundry work, welding, manufacturing, or construction work** **• The subcategories of CBRN-DP include chemical, biological, radiological, nuclear, dust, particulate matter compounds**
L	**"L"ifting** or activities with hand/arms at work • Lifting/physical burden/holding heavy objects, repeated movements, awkward postures/high force/vibration exposures
T	Over**"T"ime** work or **"T"ravel** related to work • More than 12 h/d or 40 h/wk, irregular schedules • Working more than one job • Fatigue, decreased sleep due to work, short periods of time between shifts (less than 11 hr) • Travel often/substantial amounts of travel for work, variable/transient work locations • Other disruptions of circadian rhythm patterns
H	**"H"olding the same position, "H"earing and other sensory exposures, other "H"arsh work conditions** • Sitting or standing (static loading) - For long periods of time, on average, during a workday or shift - Continuously • Noise, temperature, light extremes • Work organization issues/additional work conditions of concern - Autonomy and freedom; management/coworker relationships - Safety culture/team nature of safety culture - Workplace bullying, violence

Components of the OCCHLTH Mnemonic. Part I of the mnemonic focuses on onset and symptoms/diagnosis of illness or injury. Part II focuses on potential sources of occupational exposures that may be related to an illness or injury identified with the first part. Specific details and characteristics OCCHLTH element are included as a bulleted list for each component. See text for more information.

Table 5 suggests general language HLTH component questions for patient interviews, with a summary of the application of the mnemonic to published cases. Alternatives to standard history and physical exam and diagnostic evaluation of the chief complaint are not suggested. An appropriate history and physical examination optimally include thorough questioning about symptom onset. Reviewing details of a case in situations, for example, of treatment refractoriness or uncertain etiology, using the OCCHLTH mnemonic could improve clinical decision-making and management. This overview also allows direct examination of the applicability of the mnemonic to several occupational case studies from the published literature is presented at the end of the results section and summarized in Table 5.

Literature Search Results Used to Develop the OCCHLTH Mnemonic Structure

"O"nset of Symptoms or Diagnosis

The "O" in OCC is for onset/duration of symptoms or diagnoses (Table 1). Onset can begin days, weeks, or months postexposure, eg, in occupational asthma (OA) or work-exacerbated asthma (WEA[178]), or years later, eg, for some occupational cancers.[179] Timeframes to consider are those starting in the past week, 1 week to 1 month ago, 1 to 6 months ago, 6 months to 1 year ago, or more than 1 year ago. This element serves as a reminder to consider previous clinical evaluations, work-relatedness/diagnoses, symptom changes when off work (vacation, weekend, etc), and time of exposure to symptom onset.

TABLE 2. Mean Values for Elements From the CASP Checklist for 107 Meta-analysis, Meta-regression, and Systematic Review Publications Supporting OCCHLTH Mnemonic Elements

Variable	Question	Mean Value
Q1	Did the review address a clearly focused question?	1.00
Q2	Did the authors look for the right type of papers?	0.99
Q3	Do you think all the important, relevant studies were included?	0.99
Q4	Did the review's authors do enough to assess quality of the included studies?	0.81
Q5	If the results of the review have been combined, was it reasonable to do so?	0.69
Q6	Can the results be applied to the local population?	0.99
Q7	Were all important outcomes considered?	1.00
Q8	Are the benefits worth the harms and costs?	1.00

Notes

1. Questions Q1 through Q8 are from the Critical Appraisal Skills Programme (CASP 2021) checklist for grading the quality of systematic reviews and meta-analyses.

2. The mean value is the average of the rating of 1 (meaning yes) or 0 (meaning no) response for each question across all 107 papers that were meta-analyses, meta-regression, or systematic review study designs.

3. Two questions from the original CASP checklist that are answered by stating the results and their precision were not rated using a 1 or 0 and thus these 2 elements of the total 10 on the checklist were not included in this numerical summary of quality grading results.

CASP, Critical Appraisal Skills Programme.

Mus"C"uloskeletal Conditions

The first "C" in OCC is for mus"C"uloskeletal disorders and injuries (Table 1). As one of the largest classes of occupational health effects, with, for example, point prevalence of 35% for upper back conditions in health care workers[180] to 90.6% lifetime prevalence for any MSD among farmers,[23] one mnemonic element for MSD is appropriate. The 2018 incidence rate of MSD in the United States, with lost work time, in private industry, was 27.2/10,000 full-time workers versus 35.4 in 2011.[181] The median number of days away from work for MSD cases was 12 in 2018 and 11 in 2011, for total private industry.[181] Estimated 2007 occupational MSD direct costs are $1.5 and indirect costs $1.1 billion.[182] The Bureau of Labor Statistics MSD definitions[183] informed terms for searches (Fig. 1). The first "H" (CBRN-PD compounds, etc) exposure category had no MSD associations (Table 4).

Other Key "C"onditions

The second "C" in OCC is for other key "C"onditions related to occupational exposures (Table 1). One study estimated 2 million annual deaths occur from work-related diseases, and approximately 300,000 deaths occur from occupational injuries (defined by these authors as "accidents"), globally.[103] In this report, in high-income countries (defined as 2014 gross national income per capita > US$12,735[184]), cancers (57%), circulatory diseases (23%), respiratory diseases (6%), mental disorders (4%), communicable diseases (3%), digestive system diseases (1%), and genitourinary diseases (0.4%) constitute ~95% of work-related mortality.[103] While exposures, regulations, and disease rates/distributions vary outside of the United States, international OSH data is etiologically relevant. Major organ-system health effects occur for all HLTH categories (Table 4).

"H"andling, Transporting, or Having Other Exposure to CBRN-DP Agents

The first "H" in HLTH is for handling, transporting, or otherwise having workplace CBRN-DP exposures (Table 1). Exposures in this category are associated with cancer and noncancer health effects (Table 4). No studies met inclusion criteria for this class of exposures and MSD health effects.

CBRN-DP Exposures and cancer Effects

Skin cancer is associated with burns/traumas, tar/tar pitches, mineral oils, cutting oils, bipyridyl/paraquat, pesticides, infrared radiation, and natural UV radiation.[48–50] Uveal melanoma is associated with welding or cooking jobs.[51] Pesticide exposure and work in farming and hairdressing have been associated with primary brain tumors.[141] Other studies and recommendations present evidence for lung cancer risk with work exposure to acrylonitrile, arsenic, benzidine, beta-naphthylamine, chromium, dusts, fibers, polyaromatic hydrocarbons, silica, various metals, radon progeny, chlorophenol pesticide production, petroleum refining, and rubber manufacturing.[92–99]

Asbestos and laryngeal and stomach cancer[91,100]; silica and gastric cancer[101]; airline cockpit and cabin crew work and thyroid cancer[113]; and metal, leather working, plastics/rubber manufacturing, and asbestos exposure and colorectal cancer[62,102] associations have been reported. Liver cancers are associated with occupational organic compound exposures.[103] Trichloroethylene exposure is linked to kidney cancer.[104] Tobacco, dye, chimney sweep, rubber manufacturing, foundry work, as well as benzidine and beta-naphthylamine exposure are associated with bladder cancer.[105–107]

Other associations of cancers and occupational chemical exposures include plastics industry work and breast cancer; asbestos exposure and ovarian cancer; exposure to chromium or pesticides, or working in pesticide manufacturing jobs, and prostate cancer; maternal exposure to endocrine-disrupting chemicals (eg, organohalogens and organochlorines) and testicular cancer in children; and exposure to methylene chloride and risk of multiple myeloma; and exposure to pesticides and risk of myeloid leukemia.[114–118,138,139] Cancers that are typically linked to genetics and dietary habits can also be occupational diseases. One example is increased prevalence of colorectal cancer in chemical and manufacturing workers (AF = 11%–15%[116]). In female plastics/chemical manufacturing workers, endocrine disrupting chemical exposure is associated with increased risk of breast cancer.[115]

CBRN-DP Exposures and Noncancer Effects

Dermatitis (prevalence rates of 15%–35%) and chemical burns (representing 34% of chemical injuries) occur in workers from various chemical and manufacturing occupations.[52–55] Studies have reported leukoderma (depigmentation of skin) occurring with exposure to pesticides and other chemicals.[57]

Studies suggest cardiovascular disease (CVD) associations with occupational chemical and radiologic exposures.[63,64] A meta-analysis of 26 studies found an association of occupational low-dose ionizing radiation exposure and ischemic heart disease mortality, occurring with a 15- and 20-year lag.[65] Persistent organic pollutants may be associated with dyslipidemias and atherosclerotic and vascular diseases.[66] Inhalation exposure to metals, organic compounds, silica, asbestos, vapors, dusts, gases, fumes, metal-working fluids, biomass, and radiologic agents pose risks for OA, WEA, and other nonmalignant respiratory diseases.[83–90] Occupational heavy metal exposure may pose increased risk for nephropathy among racially and economically disadvantaged persons.[108] Male and female noncancer reproductive effects are associated with work exposure to metals and endocrine disrupting chemicals.[119–128] Anemia and methemoglobinemia are associated with lead, arsine, naphthalene, and benzene exposures.[128]

Procedural and intraoperative radiation exposure in health care workers (HCWs) are associated with increased risks for cataracts, other eye injuries, and possibly other effects of chronic radiation exposure.[137,142–144] Other sensory perception effects include dyschromatopsia (color vision changes from exposure to organic solvents such as styrene) and hearing loss (from exposure to ototoxic agents); neuromotor dysfunction; peripheral neuropathies; and degenerative processes such as amyotrophic lateral sclerosis and organophosphate pesticide exposure; peripheral neuropathies and pesticide or lead exposure; manganism in welders; and Parkinson's disease and hydrocarbon exposure.[128,145–151]

TABLE 3. CASP Item Ratings for Literature Quality Grading of 103 Meta-analysis, meta-regression, or Systematic Review Publications That Support Elements of the OCCHLTH Mnemonic

Reference	Study Type	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	%
Al-Zalabani et al (2016)	MA	1	1	1	1	1	1	1	1	100
Auta et al (2018)	MA	1	1	1	1	1	1	1	1	100
Babu et al (2014)	MA	1	1	1	1	1	1	1	1	100
Boini et al (2022)	MA	1	1	1	1	1	1	1	1	100
Boniol et al (2017)	MA	1	1	1	1	1	1	1	1	100
Bousquet et al (2006)	MA	1	1	1	1	1	1	1	1	100
Bräuner et al (2021)	MA	1	1	1	1	1	1	1	1	100
Buruck et al (2019)	MA	1	1	1	1	1	1	1	1	100
Cai et al (2019)	MA	1	1	1	1	1	1	1	1	100
Camargo et al (2011)	MA	1	1	1	1	1	1	1	1	100
Cannetti et al (2020)	MA	1	1	1	1	1	1	1	1	100
Choi (2017)	MA	1	1	1	1	1	1	1	1	100
Clarke (2012)	MA	1	1	1	1	1	1	1	1	100
Coenen et al (2014)	MA	1	1	1	1	1	1	1	1	100
Coenen et al (2018)	MA	1	1	1	1	1	1	1	1	100
Coenen et al (2021)	MA	1	1	1	1	1	1	1	1	100
Eddy et al (2018)	MA	1	1	1	1	1	1	1	1	100
Eijckelhof et al (2013)	MA	1	1	1	1	1	1	1	1	100
Ekelund et al (2019)	MA	1	1	1	1	1	1	1	1	100
Elmaraezy et al (2017)	MA	1	1	1	1	1	1	1	1	100
Foucault et al (2021)	MA	1	1	1	1	1	1	1	1	100
Gholami et al (2021)	MA	1	1	1	1	1	1	1	1	100
Huang and Lan (2020)	MA	1	1	1	1	1	1	1	1	100
Kelsh et al (2010)	MA	1	1	1	1	1	1	1	1	100
Kim et al (2016)	MA	1	1	1	1	1	1	1	1	100
Krieg et al (2008)	MA	1	1	1	0	1	1	1	1	87.5
Krstev and Knutsson (2019)	MA	1	1	1	1	1	1	1	1	100
Lee et al (2016)	MA	1	1	1	1	1	1	1	1	100
Linton et al (2015)	MA	1	1	1	1	1	1	1	1	100
Liu et al (2013)	MA	1	1	1	1	1	1	1	1	100
Liu et al (2018)	MA	1	1	1	1	1	1	1	1	100
Magnavita et al (2019)	MA	1	1	1	1	1	1	1	1	100
Matityahu et al (2017)	MA	1	1	1	0	1	1	1	1	87.5
Nayman et al (2017)	MA	1	1	1	1	1	1	1	1	100
Nicholson et al (2010)	MA	1	1	1	1	1	1	1	1	100
Nielsen et al (2014)	MA	1	1	1	1	1	1	1	1	100
Nielsen et al (2016)	MA	1	1	1	1	1	1	1	1	100
Nowrouzi-Kia et al (202)	MA	1	1	1	1	1	1	1	1	100
Oddone et al (2014)	MA	1	1	1	1	1	1	1	1	100
Pahwa et al (2018)	MA	1	1	1	1	1	1	1	1	100
Palin et al (2015)	MA	1	1	1	1	1	1	1	1	100
Pejtersen et al (2015)	MA	1	1	1	1	1	1	1	1	100
Peng (2016)	MA	1	1	1	1	1	1	1	1	100
Peng (2020)	MA	1	1	1	1	1	1	1	1	100
Peng et al (2015)	MA	1	1	1	1	1	1	1	1	100
Peters et al (2023)	MA	1	1	1	1	1	1	1	1	100
Prince et al (2019)	MA	1	1	1	1	1	1	1	1	100
Rocheleau et al (2009)	MA	1	1	1	0	1	1	1	1	87.5
Romitti et al (2007)	MA	1	1	1	1	1	1	1	1	100
Sanlorenzo (2015)	MA	1	1	1	1	1	1	1	1	100
Schnatter et al (2018)	MA	1	1	1	1	1	1	1	1	100
Seidler et al (2013)	MA	1	1	1	1	1	1	1	1	100
Seidler et al (2020)	MA	1	1	1	1	1	1	1	1	100
Singh et al (2018)	MA	1	1	1	1	1	1	1	1	100
Skogstad et al (2016)	MA	1	1	1	1	1	1	1	1	100
Sponsiello-Wang et al	MA	1	1	1	1	1	1	1	1	100
Stanganelli et al (2020)	MA	1	1	1	1	1	1	1	1	100
Stocker et al (2014)	MA	1	1	1	1	1	1	1	1	100
Sun et al (2019)	MA	1	1	1	1	1	1	1	1	100
Thapa et al (2019)	MA	1	1	1	1	1	1	1	1	100
Theorell et al (2015)	MA	1	1	1	1	1	1	1	1	100
Tomioka et al (2016)	MA	1	1	1	1	1	1	1	1	100
Van der Molen (2017)	MA	1	1	1	1	1	1	1	1	100
Van der Molen (2018)	MA	1	1	1	1	1	1	1	1	100
Virtanen et al (2012)	MA	1	1	1	1	1	1	1	1	100
Vyas et al (2012)	MA	1	1	1	1	1	1	1	1	100
Wang et al (2020)	MA	1	1	1	1	1	1	1	1	100
Wiggans et al (2016)	MA	1	1	1	1	1	1	1	1	100
Zendehdel et al (2014)	MA	1	1	1	1	1	1	1	1	100
Philbrick et al (2007)	MR	1	1	1	1	1	1	1	1	100
Acke et al (2022)	SR	1	1	1	1	0	1	1	1	87.5
Bonfim et al (2015)	SR	1	1	1	0	0	1	1	1	75
Brookes et al (2013)	SR	1	1	1	0	0	1	1	1	75
Burton et al (2012)	SR	1	1	1	0	0	1	1	1	75
Co and Kwong (2020)	SR	1	1	1	0	1	1	1	1	87.5
da Silva et al (2021)	SR	1	1	1	1	0	1	1	1	87.5
Di Stadio et al (2018)	SR	1	1	1	1	1	1	1	1	100
Doolan and Ross (2020)	SR	1	1	1	0	0	1	1	1	75
Duijts et al (2014)	SR	1	1	1	1	0	1	1	1	87.5
Fishwick et al (2015)	SR	1	1	1	1	0	1	1	1	87.5
Frontiera and Ferrinho	SR	1	1	1	1	0	1	1	1	87.5
Gignac et al (2019)	SR	1	1	1	1	0	1	1	1	87.5
Gowda et al (2019)	SR	1	1	1	0	0	1	1	1	75
Guest et al (2020)	SR	1	1	1	1	0	1	1	1	87.5
Huo et al (2021)	SR	1	1	1	1	0	1	1	1	87.5
Khan et al (2019)	SR	1	1	1	1	0	1	1	1	87.5
Kivimaki et al (2015)	SR	1	1	1	1	1	1	1	1	100
Kochem and Silva (2018)	SR	1	1	1	1	0	1	1	1	87.5
Kuijer et al (2010)	SR	1	1	1	1	0	1	1	1	87.5
Mayer et al (2012)	SR	1	1	1	1	0	1	1	1	87.5
Mona et al (2019)	SR	1	1	1	0	0	1	1	1	75
Myzabella et al (2019)	SR	1	1	1	1	0	1	1	1	87.5
Nguyen et al (2021)	SR	1	1	1	0	0	1	1	1	75
Niu et al (2011)	SR	1	1	1	1	0	1	1	1	87.5
Pompeii et al (2013)	SR	1	1	1	0	0	1	1	1	75
Poole et al (2017)	SR	1	1	1	1	0	1	1	1	87.5
Proper et al (2011)	SR	1	1	1	1	0	1	1	1	87.5
Pruss-Ustun et al (2011)	SR	1	1	1	0	1	1	1	1	87.5
Quach et al (2017)	SR	1	1	1	0	0	1	1	1	75
Reed et al (2010)	SR	1	1	1	1	0	0	1	1	75
Scheftel et al (2017)	SR	1	1	1	0	0	1	1	1	75
Scotney et al (2015)	SR	1	1	1	0	0	1	1	1	75
Smith (2011)	SR	1	1	1	1	0	1	1	1	87.5
Soteriades et al (2011)	SR	1	0	0	0	0	1	1	1	50
Stanhope and Milanese (2016)	SR	1	1	1	0	0	1	1	1	75
Vedaa	SR	1	1	1	0	0	1	1	1	75
Warembourg et al (2017)	SR	1	1	1	0	0	1	1	1	75

Notes:

1. Questions labeled Q1 through Q8 in this table are defined in Table 2.

2. A grade of 1 = yes, where the element is present, and 0 = no, the element is not present in the desired manner.

3. The "%", or percent, is the percent of questions, out of 8, that were rated with a 1 = yes.

CASP, critical appraisal skills program; MA, meta-analysis; MR, meta-regression; SR, systematic review.

Occupations in law enforcement, agriculture, rubber manufacturing, waste and recycling, laboratory animal work, health care, and biomedical device maintenance work place workers at increased risks for infectious diseases.[24,84,152,165–172] Information on hepatitis and human immunodeficiency virus (HIV) transmission through blood borne pathogen exposure in HCWs supports prevention, prophylaxis, and long-term follow-up guidance.[109,110] Tuberculosis is a concern in HCWs and migrant agricultural workers.[173] Persons with silicosis have a 2.8- to 39-fold higher risk of developing tuberculosis.[174] Transmission of SARS-CoV-2 during the COVID-19 pandemic occurred differentially, such as for infection prevalence based on the work context (eg, access to personal protective equipment, patient care responsibilities, etc), for HCWs,[173] or across different occupational groups.[176]

TABLE 4. Examples of Occupational Exposure and Health Effect Associations Contributing to Elements of the OCCHLTH Mnemonic

Health Effect Characteristics and Types	Occupational Exposure Examples (Types of Health Effect/Example Exposures)			
	"H"andling or transport of, exposure to CBRN-DP	**"L"ifting or activities with hand/arms at work**	**"T"ime and travel**	**"H"olding, Hearing, other Harsh conditions**
Exposure "**O**"nset	Onset can vary from acute (minutes to days) to months to years. Onset in the OCCHLTH questionnaire is categorized into within last 6 mo, earlier than the previous 6 mo, and better when away from or at work. Also, it should be noted whether a doctor has evaluated/diagnosed this problem			
Mus"**C**"uloskeletal		• LBP/lifting loads greater than 25 kg, or more than 25 lifts/day; standing more than 4 hr in workday in various agriculture, IT occupations[23–27] • Neck-shoulder symptoms/ cognitive or emotional stress, work pace, work precision[28] • Shoulder complaints/MMH, vibration, trunk flexion or rotation, working with hands above shoulders[29–31] • Osteoarthritis/physical loading, full-body vibration, kneeling/ squatting/bending[32–35] • Increased MSD with acute intense exercise among those using statins[36]	• Increased risk for MSD/irregular work schedules[37]	• Various MSDs/holding awkward postures among musicians[38,39] • Rhabdomyolysis, exertional heat stroke, malignant hyperthermia / heat extremes[40,41] • Musculoskeletal symptoms/lean production effects such as automated work pace and lack of recovery time[42] • Difficulty with lifting tasks in cancer survivors/work ability factors, coping issues with respect to completing job tasks[43] • LBP/overall job control, decision authority, social support measures[44] • Musculoskeletal pain complaints/ workplace bullying[45] • Trauma/workplace type II violence (violence by clients, patients, and/or visitors on workers)[46,47]
Other key "**C**"ondiions				
Dermal	• Skin cancer/burns or traumas, tar or tar pitches, mineral oils, cutting oils, bipyridyl or paraquat, pesticides, infrared radiation, natural UV radiation[48–50] • Uveal melanoma/welding, cooking workers[51] • Dermatitis and burns/metals, detergents, resins, organic compounds[52–55] • Chemical leukoderma/pesticides, other chemicals[56]	• Dermal infections associated with hand, upper extremity, foot, lower extremity injuries/ construction, agricultural work[57,58]	• Cellulitis type infections/travel[59]	• Burns, dermatitis, skin cancer/ sunlight, heat, temperature exposure[40,41,60,61]
Cardiovascular/ peripheral vascular	• HTN/organic compounds[62] • CVD/chemical, radiologic agents[63,64] • IHD/ionizing radiation[65] • Dyslipidemias, atherosclerotic disease, associated vascular diseases/ persistent organic pollutants[66]	• HAVS/vibration[67]	• Stroke/working more than 55 hr/wk[68] • Myocardial infarction / shiftwork[69] • Ischemic heart disease/shift work, night work, rotating shifts[70] • Deep vein thrombosis/travel that includes remaining in one position for long periods of time, eg, sitting for long periods, for example in truck drivers, travel across time zones[71–75]	• Varicose veins/prolonged standing[76] • CHD/40% increased risk with long-working hours (more than 10 hr/d, 40 hr/wk, self-report overtime)[77] • CVD/prolonged overall sitting[78] • CVD during on-duty times/fire fighters with underlying CVD[79] • HTN/noise, job strain[80,81] • IHD/control dimension of job strain[82]
Pulmonary	• Rhinitis, sinusitis, asthma, COPD, hypersensitivity pneumonitis, pneumoconioses/chemicals, biological agents, dust, particulate matter[83–90] • Laryngeal cancer/asbestos[91] • Lung cancer/chemicals[92–99]			

Continued next page

TABLE 4. *(Continued)*

Health Effect Characteristics and Types	Occupational Exposure Examples (Types of Health Effect/Example Exposures)			
	"H"andling or transport of, exposure to CBRN-DP	**"L"ifting or activities with hand/arms at work**	**"T"ime and travel**	**"H"olding, Hearing, other Harsh conditions**
Renal/gastrointestinal/ hepatic	• Stomach cancer/asbestos, silica[100,101] • Colorectal cancer/chemicals[62,102] • Hepatic cancer/organic compounds[103] • Renal, bladder cancer/dyes, trichloroethylene, other chemicals[104–107] • Nephropathy/metals[108] • Hepatitis/correctional, first response, health care, maintenance/ waste workers[109,110]		• Gastrointestinal infections/ travel[111] • Hepatitis/travel[112]	
Endocrine/ reproduction	• Thyroid cancer/airline cockpit, cabin crew work[113] • Breast cancer/metals, endocrine disrupting chemicals[107,114,115] • Ovarian and prostate cancer/metals, endocrine disrupting chemicals[116,117] • Testicular germ cell tumors/maternal endocrine disrupting chemical exposure[118] • Endocrine dysfunction, pregnancy effects, birth defects/metals, endocrine-disrupting chemicals[119–128]	• Pregnancy outcomes/lifting, awkward postures[129]	• Breast cancer/shiftwork[130–132] • Neuroendocrine disruption/night or irregular shiftwork that disrupts circadian rhythms[133] • Fertility and pregnancy adverse outcomes/shiftwork[134,135]	• Stillbirths, spontaneous abortions, preterm deliveries/ prolonged occupational standing[136] • Type 2 diabetes mellitus/ prolonged overall sitting[78] • Endocrine dysfunction/shift work, altered light exposures[67,127,137]
Hematologic	• Multiple myeloma/methylene chloride[138] • Myeloid leukemia/pesticides[139] • Anemia, methemoglobinemia/ metals, organic compounds (lead, arsine, naphthalene, benzene)[128]		• Malaria/travel[140]	
Neurologic/ psychiatric	• Primary brain tumors/pesticide exposure, working in farming and hairdressing[141] • Cataracts, eye injuries/chronic radiation exposure[142–144] • Dyschromatopsia/organic solvents, styrene[145] • Hearing loss/ototoxic chemicals[146] • Peripheral neuropathy/lead, pesticides,[147,148] • Neurodegenerative disorders - ALS, Parkinson's disease, Manganism/ organophosphates, hydrocarbons, metals (Mn)[149–151]	• Chronic pain/work-related lifting tasks[66]	• Mood-related disorders/night or irregular shiftwork that disrupts circadian rhythms[146]	• Hearing loss/noise exposures, for example, among waste collection, mining/work products and building/real estate construction workers[152,153] • Conflict between physiologic sleep-wake and light/dark cycles (circadian disruption)/night shift workers (day-sleepers)[154] • Work-related stress/management factors[155,156] • Mental health problems, depressive symptoms, sleep disturbances, increased stress responsivity, sickness absence/ workplace bullying, violence[45,157–161] • Trauma/workplace type II violence (violence by clients, patients, and/or visitors on workers)[46,47] • Work stress, lower job satisfaction/euthanasia tasks in veterinarians[162] • PTSD/confronting death among first responders, military personnel[163] • Mental health outcomes/health care workers during COVID-19 pandemic[164]

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TABLE 4. *(Continued)*

Health Effect Characteristics and Types	Occupational Exposure Examples (Types of Health Effect/Example Exposures)			
	"H"andling or transport of, exposure to CBRN-DP	"L"ifting or activities with hand/arms at work	"T"ime and travel	"H"olding, Hearing, other Harsh conditions
Metabolic/infectious disease	• Various infectious diseases/work in law enforcement, agriculture, rubber manufacturing, waste and recycling, laboratory animal work, health care, and biomedical device maintenance[24,84,152,165–172] Tuberculosis/migrant agricultural workers, health care workers, occupational silica exposure[173,174] • Differential SARS-CoV-2 transmission/HCWs versus non-HCWs[175,176]	• Deep tissue infections associated with hand, upper extremity, foot, lower extremity injuries/ construction, agricultural work[57,58]	• Metabolic syndrome/shiftwork causing circadian rhythm disruption[177] • Systemic and emerging infectious diseases/travel[112]	• Dehydration, heat-related illness / increased temperature, humility, radiating heat, metabolic heat from physical exertion, exacerbation of heat effects from PPE use[40,60]

Examples of occupational exposure and health effect associations illustrating OCCHLTH mnemonic elements. Associations are presented in the structure of the mnemonic to demonstrate the utility of the OCCHLTH tool as an organizational and memory aid. The types of health effects, examples of exposures, associations, and supporting literature presented in this table are not exhaustive but are meant to represent exposures and outcomes in occupational populations, and common health conditions that have been found to be associated to some occupational exposures, based on evidence in the published literature in the form of systematic reviews, meta-analyses/regressions, other seminal reviews/studies, and guidance/recommendation sources.

ALS, amyotrophic lateral sclerosis; CBRN-DP, chemical, biological, radiological, nuclear, dust, particular mater; CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; HAVS, hand-arm vibration syndrome; HCW, health care worker; HIV, human immunodeficiency virus; HTN, hypertension; IHD, ischemic heart disease; IT, information technology; LBP, low back pain; MI, myocardial infarction; MMH, manual material handling; Mn, manganese; MSD, musculoskeletal disorders; MX, management; NIOSH, National Institute for Occupational Safety and Health; TRUE patch test, thin-layer rapid use epicutaneous patch test.

"L"ifting and Other Physical Activities

The "L" in HLTH is the cue for workplace exposure to lifting, repeated movement, awkward posture, high force, or vibration-related activities (Table 1). No studies were found for exposures in this category and cancer, pulmonary, renal, gastrointestinal, hepatic, or hematologic effects meeting inclusion criteria (Table 4). Meta-analysis of eight longitudinal studies of occupational lifting found increased odds of chronic low back pain (LBP) per 10 kg lifted, per 10 lifts/day, for occupational lifting of loads >25 kg, and >25 lifts/day in those with lifting tasks compared to those without.[25] Another meta-analysis of 49 studies found an overall increased odds ratio for low back symptoms associated with occupational standing for more than 4 hours in a workday.[26] Studies have found LBP to be associated with work in occupational sectors as disparate as agriculture and information technology.[23,24,27]

Meta-analysis of 16 laboratory studies of simulated workplace stressors and neck-shoulder and forearm MSD found equal effects from cognitive/emotional stressors, workflow pace, and work-task precision requirements.[28] Systematic review of 21 longitudinal studies found shoulder complaints associated with increased odds for manual material handling, vibration, trunk flexion/rotation, and working with hands above shoulder level.[29] Meta-analysis of seven studies found moderate evidence that arm-hand elevation and shoulder loading can double the incidence of subacromial pain syndrome.[29] A pooled analysis of updates to the studies used in this previous meta-analysis found a 21% increase (95% CI: 4–41%) per 1000 hours of work with hands above shoulder level for adverse shoulder outcomes of rotator cuff syndrome, bicipital tendinitis, calcific tendinitis, impingement, and bursitis.[31]

Another meta-analysis of 69 studies reported strong and moderate evidence of workplace lifting, cumulative physical loads, full-body vibration, and kneeling/squatting/bending exposure associations with osteoarthritis (OA) among men and women.[32] Meta-analysis of 23 studies found increased hip OA with heavy physical workload among men but not women.[33] Evaluation of 71 studies suggested that physically demanding jobs and occupations were associated with an increased risk of knee OA, versus sedentary work and/or low-exposure groups.[34] Another meta-analysis of 28 studies suggested that lifting heavy loads (>10 kg [22 pounds]), squatting/kneeling, standing (>2 hours daily), and walking in farming, floor laying, and brick laying jobs contributed to lower extremity OA.[35]

Recommendations exist for lifting and awkward postures during pregnancy.[129] Eight studies found associations long work hours, defined as "overtime" and "shifts longer than 8 hours," with increased neck and back MSD.[37] Vibration-induced white finger, a type of hand-arm vibration syndrome vascular injury, is associated with cumulative lifetime vibration.[67] Acute infections (dermal and deep tissue) and disability are reported in construction-[57] and agriculture-[58] related hand and upper extremity injuries. Meta-analysis of 16 studies found increased MSD with increased musculoskeletal activities in statin users.[36]

Over "T"ime, "T"ravel, and Other Work Schedule Factors

The "T" in HLTH is the cue for work times and travel (Table 1), with exposure-outcome associations found across all organ systems examined (Table 4). This category includes working 12+ hr/d or 40+ hr/wk, working more than one job, fatigue, decreased sleep due to work, travel often/substantially for work, and/or variable/transient work locations.

Analysis of 2004–2007 National Health Interview Survey data found that 29.9% of civilian workers reported ≤6 hours sleep/night.[185] Shift work causing circadian disruption is designated a probable human carcinogen (group 2A) for breast cancer.[130,131] Evaluation of seven meta-analyses across 30 cohort and case-control studies from 1996 to 2016 suggests greater breast cancer risk with night shiftwork.[132] Cosmic and UV radiation exposure is associated with increased melanoma incidence in airline pilots and crew.[50]

Working >55 hr/wk was associated with an increase in incident stroke in workers without stroke history, controlling for other risk factors and study design, in a meta-analysis of 603,838 persons (25 studies) from Europe, the United States, and Australia.[68] A systematic review of 34 studies in 2,011,935 persons found shift work to be associated with myocardial infarction.[69] An umbrella review of systematic reviews with or without meta-analyses found evidence strongly supporting a 10% excess risk of diabetes with any type of night work, a 25% risk of being overweight for shift workers overall, and a 30% excess risk of hypertension using a broad definition of shift work that included night and rotating shifts.[70] In general, CVD mortality and MI

TABLE 5. The OCCHLTH Mnemonic Subgroupings of Exposures and General Terminology Questions and Example Cases

Screening Tool Detail for General Issues		Suggested General Terminology Question	Case 1[1]	Case 2[2]	Case 3[3]
History and physical examination, radiographic/laboratory information		No specific questions proposed; use standard clinical approach	26 yr/o F; NS; no medications CC: 1 wk of throat congestion, postnasal drip, daily face flushing, skin reaction to previously worn earrings and belt buckle. **MX, Seen by PCP, diagnosed with sinus infection, given amoxicillin with no improvement;[1]** CXR WNL; CT of facial bones, sinuses with some R maxillary sinus, otherwise unremarkable; PFT: WNL, 16% improvement with bronchodilators Evaluated by allergist with a TRUE patch test, with positive reaction to nickel, molds, cat dander	28 yr/o M; NS; no medications CC: chest tightness, shortness of breath, coughing; **MX, Prescribed a salbutamol (albuterol) inhaler by family physician; some symptom improvement;[2]** CXR and electrocardiogram WNL 1 mo after symptoms started; PFT WNL 1 mo after symptoms started; post bronchodilator challenge had only 2% improvement in FEV1; 3 mo after symptom start, filaments changed to polylactic acid, workplace air purifier installed; further symptom improvement; 8 mo after symptom start, symptoms persisting; methacholine challenge found 20% fall in FEV1, consistent with mild asthma; 15 mo after start of symptoms and 12 mo after workplace changes, PFT WNL	47 yr/o M; unknown tobacco use; CC: 6 yr of increasingly frequent, and now daily and constant head pain; Occasional headache for previous 15 yr; medical history of viral encephalitis, deviated septum repair, motion sickness; family history of migraine; Optimization with lifestyle (hydration, nutritional support) and medications did not adequately control symptoms; **MX, 6 mo prior to presentation to clinic, switched to dayshifts with work accommodation;**
OCC: • Standard history and physical exam approaches can be used. • Temporal relationship of exposures & symptoms/diagnosis is important to investigate		How long have you been working in your current job? How long have you been having this problem? Is there any change in symptoms when at work or not at work?	Formulation chemist × 3 yr; Transition to new chemical exposures 1 wk before symptoms started	Symptoms appeared 10 d after starting a 3D printing business; Symptoms present when at work and improved on weekends	Past 6 yr, after transitioning to working night shifts; Typically, 2–3 hr after the end of many night shifts, headaches occur that could last until the following day;
Screening tool detail for exposures	Subgroupings of Exposures				
H "H"andling of, transport of, or exposure to CBRN-DP	Chemical Biological Radiological Nuclear Dust/particulate matter	Do you handle/transport or are you exposed to chemical/biological/radiological/nuclear agents or dust/particulate matter at work? Do you work in any foundry, welding, manufacturing, construction, agriculture, or health care jobs/tasks?	Yes; long-standing exposure to polymers; new exposure to nano nickel powder	Yes; work with 10 machines for 3D printing; machines use acrylonitrile-butadiene-styrene plastic filaments;	NR
L "L"ifting; activities with hand/arms • Repeated lifting/manual activities	Lifting/physical burden/holding heavy objects	Do you lift or carry heavy loads at work?	NR	NR	NR
• Awkward postures	Repeated movements	Do you do repeated movements at work?	NR	NR	NR
• Force or vibration	Awkward postures; high force; vibration exposures	Do you stand or sit in unusual ways at work? Do you have to apply high amounts of force when you work? Do you work with vibration causing equipment or in places with whole body vibration?	NR	NR	NR

Continued next page

TABLE 5. *(Continued)*

Screening Tool Detail for General Issues		Suggested General Terminology Question	Case 1[1]	Case 2[2]	Case 3[3]
T Over"T"ime work or "T"ravel related to work • More than 12 h/d or 40 h/wk • Irregular schedules • Working more than one job	Excessive time at work; irregular, rotating, or other unusual work schedules	Do you work long or irregular hours, for example night and day, or other unusual work schedules in the same week?	NR	NR	Switching back to night shifts resulted in recurrence of headaches;
	Sleep	Do you get enough sleep routinely?	NR	NR	NR
• Fatigue • Decreased sleep due to work. • Travel often/ substantial amounts of travel for work, variable/ transient work locations • Other circadian rhythm disruptions	Travel	Do you travel for work, and if so, when did you last travel and to/ from where?	NR	NR	NR
H "H"olding the same position, "H"earing Exposures, other "H"arsh work conditions • Sitting or standing - For long periods of time, on average, during a workday or shift - Continuously • Noise, temperature, light extremes • Work organization issues/additional work conditions of concern	Static loading	Do you stand or sit in the same position for long periods of time, or continuously, at work?	NR	NR	NR
	Noise Temperature extremes Light extremes	Do you have high amounts of noise, heat, cold, dark, or light in your job?	NR	NR	NR
	Work organization: Autonomy and freedom	Do you feel you have freedom to do your work in the way you think best?	NR	NR	NR
	Work organization: Management/ coworker relationships	How are your relationships with management and coworkers in your job?	NR	NR	NR
	Work organization: safety culture; "Team nature" of safety; Workplace bullying; Workplace violence	Does your workplace have a safety of culture that includes a team approach to safety? Do you feel safe in your work environment? Do you have concerns about bullying or violence in the workplace?	NR	NR	NR

Subgroupings of the OCCHLTH mnemonic and potential general terminology questions for potential clinical use. The first column lists mnemonic elements, the second column presents element components, and the third column includes element subcategories. The fourth column presents suggested general language questions to ask patients to determine subcategory status. Questions are suggestions only and not the result of formal question construction/validation activities. The fifth through seventh columns present details of published cases of occupational illnesses to explore the utility of the mnemonic in organizing and thinking about work-relatedness.

Notes on cases:

1. Details are from a case report presented by Journeay and Goldman (2014) of acute respiratory and dermal symptoms after 1 week of occupational handling of nickel nanoparticles. The bolded information is important because in this case, the patient was initially evaluated and treated for a sinus infection with antibiotics.

2. Details are from a case report presented by House and colleagues (2017) of asthma after 10 days of exposure to 3D printing that used acrylonitrile-butadiene-styrene plastic filaments. The bolded information is important because in this case, the patient had a childhood history of asthma that had resolved but was possibly an element in treating the patient with a steroid inhaler. However, spirometry was unremarkable.

3. Details are from a case report presented by Sandoe and colleagues (2019) of migraine in a patient who works night shift that did not resolve with optimization of lifestyle and medication changes but improved significantly after transitioning to a fixed day schedule. The bolded information is important because 6 months of day shift resulted in improvement of symptoms, with subsequent return to night shifts causing recurrence of migraines with no changes in other lifestyle and medication parameters.

3D printing, process of making three-dimensional solid objects from a digital file; CBRN-DP, chemical, biological, radiological, nuclear-dust, particulate matter; CC, chief complaint; CT, computed tomography scan; CXR, chest x-ray; F, female; FEV1, forced expiratory volume in 1 second; M, male; MX, management; NR, not relevant; NS, nonsmoking; PCP, primary care physician or primary care provider; TRUE patch test, thin-layer rapid use epicutaneous patch test; WNL, within normal limits; yr/o, years old.

are decreasing in developed countries, but CVD prevalence might be increasing if acute coronary syndromes are counted.[186] For work-related travel, prolonged flight times are associated with a 3% to 12% risk for deep vein thrombosis.[71,72]

Circadian rhythm disruption, for example, from night or irregular shiftwork, or sleep disturbance, is associated with neuroendocrine disruption,[133] mood alterations,[187] and increased metabolic syndrome.[177] Shift work is associated with adverse fertility and pregnancy outcomes.[134,135] Crashes on public roadways constituted 25% of all work-related fatalities in 2012.[188] A systematic review of studies in medical residents found decreased shift length to be associated with fewer self-reported motor vehicle crashes.[189] Quick returns to shift, with between shift durations of 11 hours or less, were associated with increased sleepiness and fatigue in a systematic review of quick return night shift work in 21 studies.[190]

Travel exposures increase the risk of infectious diseases,[112] with 3% to 19% of travelers to the developing world returning to the United States with a fever, or potential for fever, within weeks of returning.[191] Travel exposure to marine flora/fauna, bodies of water, or compromised drinking water is associated with increased risk for skin disorders, such as cellulitis, or more fulminant gram-negative or mycobacterial infections[59]; gastrointestinal diseases, such as *Giardia lamblia* or *Campylobacter jejuni* infections, hepatitis, meningitis, and a range of other bacterial, viral, parasitic, or other infections[111,112]; hematologic infections, such as malaria[140]; or emerging infections.[112]

Disordered sleep, associated with various adverse effects,[192] can be experienced during travel across time zones.[193] Air travel is associated with increased lower extremity edema and venous thromboembolism risk.[71–74] One systematic review of 73 studies examined trucking industry workers, globally.[75] Important factors reported included enforced sedentarism, long and irregular working hours, lack of healthful foods, social isolation and chronic time pressures, associated with overweight/obesity, hypertension, hypercholesterolemia, high blood glucose, poor mental health, and cigarette smoking.[75] Work time and travel affect circadian rhythms and all body systems.

"H"olding the Same Position, "H"earing, and Other "H"arsh Work Conditions

The second "H" in HLTH is the cue for "H"olding (static loading) one position for long periods; "H"earing and other sensory exposures; and other "H"arsh conditions (Table 1). This element may be the most challenging, because it contains disparate exposures. Other categorizations that were considered, however, led to more complex mnemonic structures. Static loading (continuously maintaining the same position) for long periods of time is a harsh exposure and is, thus, grouped in the "H" cue. Exposures in this category were related to outcomes in all organ systems examined (Table 4).

"H"olding the Same Position: For Continuous or for Intermittently Extended Periods of Time

Any physical activity, regardless of intensity, was found to be associated with decreased all-cause mortality in meta-analyses of eight studies.[194] A systematic review of 132 publications found that office workers had the greatest sedentary time during awake hours, and laborers the least; and workers in driving professions tended to have higher body mass index and blood pressure values.[195] Prolonged standing was associated with increased varicose veins in a systematic review of 21 studies of persons in various work conditions.[76] Prospective studies support associations of prolonged occupational standing with increased risk of stillbirths, spontaneous abortions, and preterm deliveries.[136] A systematic review of 14 prospective studies found strong evidence (defined as consistent findings in two or more high-quality studies) of a positive relationship between overall time spent sitting and risk for type 2 diabetes and CVD mortality.[78] String instrument players and flutists, who can remain in lengthy awkward postures while playing, have increased risks for MSDs.[38,39]

"H"earing: Noise, Temperature, and Light Extremes

About 22 million US workers experience hazardous workplace noise exposures.[153] One analysis found an 18% prevalence of occupation-related hearing loss globally, based on audiograms for the years 2000–2008, among male and female workers aged 18–65, with the greatest hearing loss among mining/wood products and construction workers.[153] A systematic review of 41 articles about professional musicians suggested a higher prevalence of hearing loss among those in pop/rock versus classical music genres.[196] A systematic review of waste collection worker studies found 2 (out of 19 studies with health outcomes) with hearing loss as an adverse effect.[152] Occupational noise exposure was associated with hypertension (hazard ratio [HR]: 1.68, 95% CI: 1.10–2.57), CVD (HR: 1.34, 95% CI: 1.15–1.56), and cardiovascular mortality (HR: 1.12, 95% CI: 1.02–1.24) in a meta-analysis of 12 prospective studies.[80]

Heat-related illness can result from increased temperature, humidity, radiating heat, or metabolic heat from physical exertion; the use of personal protective equipment can exacerbate heat effects.[40,60] In heat-related illnesses such as exertional heat stroke, rhabdomyolysis and malignant hyperthermia are additional concerns.[40,41] One systematic review found increased rates of squamous cell carcinoma of the skin and basal cell carcinoma in outdoor workers compared with indoor workers across three meta-analyses.[61] A systematic review found that night shift workers develop a conflict between physiologic sleep-wake and light/dark cycles, leading to significant circadian disruption.[154] The subcategories of temperature and light/dark exposures are difficult to define and measure but has important health effects, potentially due to sequelae from circadian rhythm disruption.

Other "H"arsh Conditions: Work Organization Issues/ Additional Work Conditions of Concern

One evaluation of 103 articles and chapters suggested that job insecurity and other work organization hazards are associated with occupational health disparities.[197] One review of 36 studies of lean production effects found that an increase in automated work pace and lack of recovery time in manufacturing occupations negatively affected musculoskeletal symptoms.[42] A systematic review of 20 studies of cancer survivors returning to work found that psychosocial problems, such as coping issues with respect to completing job tasks, influenced work ability and may influence physical factors such as difficulties with lifting.[43] Meta-analysis of 18 studies, representing a pool of $N = 19{,}572$ study subjects, found overall positive job control, decision authority, and social support measures to be associated with decreased odds of chronic LBP.[44]

A systematic review of 44 studies found a 20% increased risk in ischemic heart disease (IHD) associated with job control aspects of job strain in two studies.[82] Meta-analysis of data from nine studies of job strain found increased odds of hypertension.[81] A systematic review suggests that CVD events occur in fire fighters and first responders with underlying CVD, with greater frequency at specific times of day, periods of the year, and during or after taxing, stressful duties compared with routine work.[79] Authors of an early meta-analysis on long working hours and coronary heart disease (CHD) noted that results from prospective studies in this analysis suggested an approximately 40% excess risk of CHD associated with working long hours.[77] Although long work hours and cardiovascular endpoint associations were noted in the "T"ime element, they are reiterated to emphasize the *harsh* nature of this exposure. Another meta-analysis of 21 publications found associations of working night shifts, physical or mental fatigue, and high job demand with increased sickness absence from work.[155]

A systematic review of 13 studies in Europe (sample sizes of 91 to 67,347), of health care workers, police officers, and other workers, found a positive relationship between work stress and management factors, such as low demands, high control, positive managers' support plus peer support, strong relationships, defined work role, and effective management/communication of organizational change.[156] A

meta-analysis of 45 publications was reported as findings significant inverse correlations between the report of the experience of workplace stressors and measures of safety participation (defined as participation in health and safety activities), safety-citizenship behavior, making safety suggestions, safety-related worker involvement, and ensuring coworker safety.[198]

A systematic review of 24 studies suggested an association between bullying and sleep disturbances.[157] Despite study design differences, meta-analysis of nine studies found increased odds for sleep problems associated with workplace violence.[158] A systematic review of 59 studies found "moderately strong evidence," of bullying associated with depressive symptoms in a mixed-gender study sample and in a bullying in a sample of women.[159] Meta-analysis of 2541 participants across 14 articles found correlations between increased hypothalamic-pituitary-adrenal axis activity (suggesting stress responsivity) and measures of effort-reward imbalance and overcommitment.[160] Another meta-analysis of 10 studies found associations between workplace bullying and sickness absence.[161] A meta-analysis found correlations between bullying and mental health problems and somatic symptoms, eg, chronic neck pain.[45] A systematic review of 31 of 84 "moderate- to high-quality" studies,[46] and a review of 17 hospital setting studies,[47] suggests type II violence (client/patient/visitor violence against hospital staff) is a serious hazard.

The authors of a systematic review of 12 studies of veterinary medical professionals concluded that greater work stress and lower job satisfaction were associated with euthanasia procedure work, which may relate to higher employee turnover, psychological distress, and stress-related health effects.[162] Meta-analysis of seven studies of military personnel or first responders found increased odds for the association of occupational confrontation with death and posttraumatic stress disorder.[163] A systematic review of nine studies in HCWs, employed during the COVID-19 pandemic, defined nine factors of depression, anxiety, inadequate support, occupational stress, productivity at work, workplace preparedness, financial concerns associated with income/daily living, fear of transmission, and burnout/fatigue that affect work performance and mental health.[164]

Exploring the Clinical Applicability of the OCCHLTH Mnemonic

Memory aids for processes, such as SAMPLE, are not always amenable to formal validation, but some, such as the CAGE questions, have undergone some validation assessment after initial publication.[20] The way in which SAMPLE is used, along with difficulty in validating a tool of this kind, and the targeted question format of both mnemonics illustrated important issues that were considered when constructing the OCCHLTH mnemonic. While a formal validation of the mnemonic was not conducted, the utility of the mnemonic was explored by applying it to information for several published cases, providing insights into the role of the mnemonic in clinical cases. Table 5 presents case details and answers for suggested mnemonic category questions.

The first case of a 26-year-old chemist, nonsmoker, working for 3 years in her present job[199] highlights a role of the mnemonic for diagnosis and management. The patient presented with a 1-week history of respiratory symptoms, daily skin flushing, and dermal allergy to earrings and a belt buckle, made with mixed metals. Initial evaluation and treatment for a sinus infection included prescription of amoxicillin, without improvement. Applying the OCCHLTH mnemonic to this case, given the acute appearance of respiratory and dermal symptoms, finds utility in the questions (1) "How long you had been working in your job?" (2) "Has anything changed recently?" (3) "Does your job involve "H"andling of, transport of, or exposure to CBRN-DP?" Latter occupational history taking revealed work with nickel nanoparticles beginning 1 week before symptom onset. Limiting work exposure to nano nickel particulates resulted in patient improvement.[199]

The second case involved a 28-year-old self-employed businessman with a childhood history of asthma that had resolved by the age of 8.[200] The patient reported recurrent chest tightness, shortness of breath, and coughing while at work beginning 10 days after he started using 10 fused deposition modeling 3D printers with acrylonitrile-butadiene-styrene filaments. Initial evaluation resulted in the patient being started on the prescription of a salbutamol (albuterol) inhaler. One month after symptom start, pulmonary function testing (PFT) was within normal limits, although symptoms persisted. Applying the OCCHLTH mnemonic to this case, given the acute appearance of respiratory symptoms suggestive of asthma but normal PFT results, finds utility in the questions (1) "How long you had been working in your job?" (2) "Has anything changed recently?" (3) "Does your job involve "H"andling of, transport of, or exposure to CBRN-DP?" Further questioning may have revealed that the work area was about 3000 cubic feet, with work occurring near the printers and no air filtration system. Workplace changes 3 months after symptom start included decreased numbers of printers, changing to polylactic acid filaments, and installing an air purifier. Eight-month PFT results suggested mild asthma. Return to normal PFT results occurred 15 months after symptom start, or 12 months after workplace changes occurred.[200]

The third case involved a 47-year-old with a 6-year history of headache occurring more frequently, which at presentation occurred daily and were constant, typically starting 2 to 3 hours after ending a nightshift.[201] Treatment consisted of lifestyle modification (hydration, improved nutrition, and mindfulness) and medications, such as rizatriptan combined with ibuprofen, without improvement. Changing to a day only schedule resulted in significant improvement in headaches. Subsequently changing back to night shifts resulted in the headaches returning. Applying the OCCHLTH mnemonic to this case, given the recurrence of headaches with return to nightshift, finds utility in the questions (1) "How long you had been working in your job?" (2) "Has anything changed recently?" (3) "Does your job involve over 'Time' or 'Travel'?" Ultimately, a permanent return to day shifts was recommended, and this resulted in almost complete resolution of headaches and no need for preventive medications.[201]

DISCUSSION

The OCCHLTH mnemonic, while not a formal screening or diagnostic tool, aims to increase health care providers' clinical awareness of occupational etiologies in illness and injury. Learning the OCCHLTH mnemonic requires some study. It provides a structure to organize and recall OM principles and information. The structure, based on exposure-outcome/body system information and exposure and organ system subcategories, draws on classic OSH history-taking principles and systems clinical logic, SME input, and published evidence on occupationally important exposure-outcome associations.

Different users can apply the OCCHLTH mnemonic. Nonoccupational medicine physicians can apply it when evaluating patients to consider workplace exposures in the etiology of illnesses and injuries. As a memory aid that synthesizes a broad knowledge base of workplace exposure-outcome associations, it provides a ready reference that adds an important dimension to patient evaluation and management. The tool provides a format for life-long learning to assimilate evolving science on occupational exposure-outcome associations for nonoccupational and OM clinicians. The mnemonic can serve as an OM curriculum blueprint for non-OM programs, with the OCCHLTH structure acting as a roadmap to teaching occupational exposure and associated outcome information.

Increased clinical suspicion for work-related illness and injury has implications for treatment refractory situations and could prompt earlier consultation of clinical specialists to improve health outcomes. Conditions with [1] long latencies or inexplicably aggressive time-courses; [2] nonspecific presentations with enough discomfort that patients seek care; or [3] treatment refractory or idiopathic natures may

have occupational bases.[1–8] In the non-OM setting, at least one positive finding in the OCC and HLTH parts, consistent with associations described in this work, or supported by evidence of a level similar to criteria in this work, or supported by significant clinical evidence, such as multiple cases found in workers from a similar work setting, suggest a potential occupational etiology and could prompt the consideration of roles for OM and/or other specialists in clinical management. An additional OSH resource to consider if occupational etiologies are of concern is the National Institute for Occupational Safety and Health (NIOSH), including the Products and Publications page (NIOSH Publications and Products | NIOSH | CDC), a gateway to NIOSH information, the searchable NIOSHTIC-2 database (NIOSH Technical Information Center – second version of the database), the NIOSH Pocket Guide to Chemical Hazards, and the NIOSH Manual of Analytic Methods.[202]

An additional resource that has relevance to the clinical setting is from the World Health Organization and International Labor Organization (WHO/ILO), which has published pairs of selected workplace exposures and associated outcome pairings important for mortality related to occupational illnesses and injuries.[203,204] This includes the association of asbestos with cancers of the trachea, bronchus, lung, ovary, larynx, and mesothelioma.[204] Other pairings are arsenic, beryllium, cadmium, chromium, and diesel engine exhaust, nickel, polycyclic aromatic hydrocarbons, and silica, respectively, with trachea, bronchus, and lung cancers and benzene with leukemia.[204] Occupational formaldehyde exposure and nasopharyngeal cancer and leukemia are also included in the WHO/ILO listing.[200] Occupational exposure to sulfuric acid associated with larynx cancer and exposure to trichloroethylene with kidney cancer are included.[204] In the area of noncancer endpoints, the association of occupational asthmagens with asthma, particulate matter, gases, and fumes with COPD, and long work hours with stroke and ischemic heart disease are in the WHO/ILO list.[204] Many of the pairings in these reports are found in the results of literature search information supporting the OCCHLTH mnemonic.

Theoretical strengths of the OCCHLTH mnemonic are its use of core occupational health history-taking components; a seven-element structure, considered ideal for memory aids[16–18]; and exposure and outcome categories. While not exhaustive, an extensive catalog of exposure-outcome associations from mechanistic, etiologic, and systematic reviews, meta-analyses, and OSH recommendations and guidelines supports the mnemonic. The agreement of the literature search results in this paper of important exposure-outcome associations with pairings from the WHO/ILO listing of associations associated with mortality reinforces the importance of considering occupational exposures in the evaluation of patients in the clinical setting. The literature search results presented here also highlight a range of exposure-outcome associations important for morbidity among working populations. Application of the mnemonic to published OM cases suggests that the structure is useful in organizing clinical information, with potential benefits for appropriate clinical management.

As noted earlier, the OCCHLTH mnemonic is an awareness raising tool to include in the toolbox of the general medicine setting. Formal occupational health history taking usually occurs in the domain of OM. While there has been discussion of the need for more residency-trained OM physicians,[205] the role of the primary care setting in raising the question of possible workplace etiologies is important for proper referral and management of workplace related in the context of an underserved OM field. While the mnemonic has utility for OM training and learning, as noted above, it is predominantly a tool for the general medicine setting. It is not intended to be a formal, definitive diagnostic tool, but a guide to the possible need for further evaluation of occupational variables. It is not an exhaustive encyclopedia of occupational exposure-outcome associations, such as emerging hazards or specialized exposure-outcome associations in a local context. However, learning the logic and applicability of the tool can inculcate a greater awareness of occupational impacts on illness and injury for evaluations of patients in the non-OM setting.

Continued exposure to work hazards, even with seemingly appropriate disease management, can mimic treatment refractoriness. Such situations can cause further harm, or at the least not provide benefit. In addition, awareness of nonwork *and* work-related factors can affect clinical management. The presence of nonwork factors for health outcomes does not rule out work exposure involvement, for example, in WEA.[206] Increased suspicion for occupational etiologies increases chances that other workers in a patient's workplace with similar exposures can receive appropriate care.[208] In addition, health care insurance system versus workers' compensation issues may affect the consideration of work etiologies.[208–214]

In conclusion, the OCCHLTH mnemonic is a tool designed to raise awareness of the possibility of occupational sources for illness and injury. Recognition that the mnemonic is not for formal screening/diagnosis is important for future validation efforts. Evaluating known occupational and nonoccupational cases using the OCCHLTH mnemonic and assessing whether occupational issues are correctly suspected may be an option for future validation efforts. The mnemonic structure can also provide an outline for the creation of questionnaires that could facilitate occupational health history taking, although this is also an effort that needs further validation. Occupational illness and injury are health concerns with significant patient and societal burden. Increased clinical suspicion may increase recognition of occupational etiologies. By increasing the chances of recognizing such problems, the OCCHLTH mnemonic may improve patient care to decrease the burden of occupational illness and injury.

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