

**IWH Research Alert**  
**July 24, 2020**

**Missed an issue? Catch up on previous *Research Alerts* available on the IWH website <https://www.iwh.on.ca/journal-articles/research-alerts>**

*Research Alert* is a service provided to you by the Institute for Work & Health (IWH) to help you keep abreast of recent literature in the areas of occupational health and safety, epidemiology, public health and others within the IWH mandate. Please note that these articles have not been reviewed by Institute scientists to assess the quality of the studies. *Research Alerts* should not be considered an endorsement of the findings. Readers are cautioned not to act on the results of single studies, but rather to seek bodies of evidence. It should also be noted that the Institute for Work & Health cannot provide full-text of articles listed in *Research Alerts* to individuals outside of the organization, as this violates copyright legislation.

**Haight JR, Sears JM, Fulton-Kehoe D, Wickizer TM, and Franklin GM. Early high-risk opioid prescribing practices and long-term disability among injured workers in Washington State, 2002-2013. *Journal of Occupational and Environmental Medicine*. 2020; 62(7):538-547.**

<https://doi.org/10.1097/JOM.0000000000001900> [open access]

**Abstract:** OBJECTIVE: To estimate associations between early high-risk opioid prescribing practices and long-term work-related disability. METHODS: Washington State Fund injured workers with at least one opioid prescription filled within 6 weeks after injury (2002-2013) were included (N=83,150). Associations between early high-risk opioid prescribing (longer duration, higher dosage, concurrent sedatives), and time lost from work, total permanent disability, and a surrogate measure for Social Security disability benefits were tested. Measures of early hospitalization, body part, and nature of injury were included to address confounding by indication concerns, along with sensitivity analyses controlling for injury severity. RESULTS: In adjusted logistic models, early high-risk opioid prescribing was associated with roughly three times the odds of each outcome. CONCLUSION: Exposure to high-risk opioid prescribing within 90 days of injury was significantly

and substantially associated with long-term temporary and permanent disability

**Kokorelias KM, Gignac MAM, Naglie G, Rittenberg N, MacKenzie J, D'Souza S, et al. A grounded theory study to identify caregiving phases and support needs across the Alzheimer's disease trajectory. Disability and Rehabilitation. 2020; [epub ahead of print].**

<https://doi.org/10.1080/09638288.2020.1788655>

**Abstract:** **PURPOSE:** Caregivers of individuals with Alzheimer's disease require support across the full disease trajectory. The aim of this study was to develop a conceptual framework of caregiving phases across the Alzheimer's disease and caregiving trajectories and the corresponding caregiver support needs. **MATERIALS AND METHODS:** Constructivist grounded theory informed data collection and analysis. 40 spousal (n=20) and adult children (n=20) caregivers were interviewed. Recruitment was completed when theoretical saturation was achieved. Member-checking interviews occurred with 10 participants. **RESULTS:** Participants described five phases of caregiving related to their responsibilities to support people with Alzheimer's disease including monitoring initial symptoms, navigating their diagnosis, assisting with instrumental activities of daily living, assisting with basic activities of daily living, and preparing for the future. Support (i.e., informational, emotional, instrumental, and appraisal) needs were often specific to the phase of care. For example, during the initial symptoms phase, caregivers reported needing information to assist them to distinguish normal aging from cognitive impairment. In contrast, during the preparing for the future phase, caregivers emphasized support for accessing institutional long term-care placement. **CONCLUSIONS:** Findings highlight caregiver-identified phases of caregiving and corresponding support needs across the Alzheimer's disease trajectory. Findings can inform the development, evaluation and implementation of programs and services to meet caregivers' changing needs across the disease trajectory. **IMPLICATIONS FOR REHABILITATION** Caregivers for individuals with Alzheimer's disease can experience distinct caregiving phases across the disease trajectory with corresponding support needs. Rehabilitation clinicians can use these findings to help caregivers navigate available supports at appropriate times to ensure

that their needs are addressed across the disease trajectory. Occupational therapists and other rehabilitation professionals can enable caregivers with timely education and support as they progress across the disease trajectory

**Minh A, Bultmann U, Reijneveld SA, Van Zon SKR, and McLeod CB. Childhood socioeconomic status and depressive symptom trajectories in the transition to adulthood in the United States and Canada. Journal of Adolescent Health. 2020; [epub ahead of print].**

<https://doi.org/10.1016/j.jadohealth.2020.05.033>

**Abstract:** **PURPOSE:** We examined whether young people in the U.S. and Canada exhibit similar depressive symptom trajectories in the transition to adulthood and compared the effect of childhood socioeconomic status on trajectory membership. **METHODS:** We used the American National Longitudinal Survey of Youth 1979 Child/Young Adult (n = 6,315) and the Canadian National Longitudinal Survey of Children and Youth (n = 3,666). Depressive symptoms were measured using five items from the Center for Epidemiological Studies on Depression scale. Latent trajectories of depressive symptoms from ages 16-25 years were identified using growth mixture models. We estimated the effect of childhood family income, parental education, and parental unemployment on trajectory membership using multivariable Poisson regression models with robust variances. **RESULTS:** We identified four similar trajectories in the two countries: (1) low stable; (2) mid-peak; (3) increasing; and (4) decreasing. Relatively more Americans were in the low-stable trajectory group than Canadians (77.6% vs. 64.9%), and fewer Americans were in the decreasing group (7.1% vs. 19.1%). In the U.S., childhood family income in the bottom two quartiles was related to higher rates of increasing trajectory membership compared with income in the top quartile (incidence rate ratios: 1.59-1.79, p < .05), but not in Canada. In the U.S., parental education at a high school level was associated with higher rates of decreasing trajectory membership compared with higher education (incidence rate ratio = 1.45, confidence interval: 1.10-1.91; p = .01), but not in Canada. **CONCLUSIONS:** Depressive symptoms may take a similar course in the transition to adulthood within these two countries. Country

differences may modify the degree to which childhood socioeconomic status determines trajectory membership

**Sears JM, Schulman BA, Fulton-Kehoe D, and Hogg-Johnson S. Workforce reintegration after work-related permanent impairment: a look at the first year after workers' compensation claim closure. Journal of Occupational Rehabilitation. 2020; [epub ahead of print].**

<https://doi.org/10.1007/s10926-020-09912-z> [open access]

**Abstract:** Purpose The purpose of this study was to descriptively quantify experiences of injured workers with permanent impairment during their first year of work reintegration. Methods A representative survey was conducted to characterize health, disability, pain, employment, reinjury, and economic outcomes for 598 workers with permanent impairment who had returned to work during the year after workers' compensation claim closure. Survey responses were summarized by degree of whole body impairment (< 10% vs. = 10%). Results Injured workers who had returned to work reported that permanent impairment made it difficult to get a job (47%) and to keep their job (58%). A year after claim closure, 66% reported moderate to very severe pain; 40% reported pain interference with work. About 13% reported new work injuries; over half thought permanent impairment increased their reinjury risk. Asked to compare current to pre-injury work status, workers with a higher degree of impairment more frequently reported working fewer hours (OR 1.60; 95% CI 1.06, 2.42), earning less (OR 1.56; 95% CI 1.04, 2.36), and being at higher risk of losing their current job due to their impairment (OR 1.66; 95% CI 1.01, 2.71). Conclusions Injured workers with permanent impairment face long-term challenges related to health limitations, chronic pain, work reintegration, and economic impacts. Workers with a higher degree of impairment more frequently reported several economic and job security challenges. Developing workplace and workers' compensation-based interventions that reduce return-to-work interruption and reinjury for workers with permanent impairment should be prioritized as an important public health and societal goal.

**Bartelink VHM, Zay YK, Guldbrandsson K, and Bremberg S. Unemployment among young people and mental health: a systematic review. Scandinavian Journal of Public Health. 2020;**

48(5):544-558.

<https://doi.org/10.1177/1403494819852847>

Abstract: Aim: The aim of this systematic review is to obtain a better understanding of the association between unemployment among young people and mental health. Methods: After screening the title and abstract of 794 articles drawn from four electronic databases, 52 articles remained for full-text reading. Of these, 20 studies met the inclusion criteria and were assessed on methodological quality. All steps were performed independently by two reviewers. Finally, a total of 17 articles were included in the systematic review. Results: Analysis of cross-sectional studies (N = 5) showed an association between unemployment among young people and mental health. An effect of unemployment on mental health was found when considering cohort studies (N = 12) that did not control for confounders (7/7). When controlling for confounders except mental health at baseline, this effect decreased in most studies leading to mixed results, although the majority (6/8) still found an effect. However, when taking mental health at baseline into account as one of the confounders, only a minority of studies (3/8) found a significant effect of unemployment on mental health. Conclusions: This systematic review showed an association between unemployment among young people and mental health. However, whether there is a causal relationship is less clear. More evidence from, for example, natural experiments and longitudinal studies that control for confounding variables, especially mental health at baseline, is required to better understand the association and potential causation between unemployment among young people and mental health

**Bovio N, Richardson DB, and Guseva Canu I. Sex-specific risks and trends in lung cancer mortality across occupations and economic activities in Switzerland (1990-2014). Occupational and Environmental Medicine. 2020; 77(8):540-548.**

<https://doi.org/10.1136/oemed-2019-106356>

Abstract: OBJECTIVES: To assess lung cancer mortality across occupations and economic activities/industries in Switzerland using three statistical estimates. METHODS: All Swiss residents aged 18-65 during the 1990 or 2000 censuses were followed through 2014 to ascertain information on date and cause of death. For every occupation and economic activity/industry, causal mortality ratios

(CMR) and standardised mortality ratios (SMR) were computed using national cause-specific mortality rates. We also calculated relative SMR (rSMR) and conducted analyses stratified by socioeconomic variables, job skill level and calendar periods. RESULTS: The study sample comprised 5 834 618 participants (111 162 348 person-years). SMR and CMR led to similar results, while rSMR were generally higher. We found 18 occupations in men, 10 occupations in women and 3 industries in each sex with an excess of lung cancer mortality. Among men, rubber and plastic products machine operators, and workers in mining and quarrying, and construction industries were at high risk. Among women, motor vehicle drivers and workers in trade, repair of motor vehicles and of domestic articles and manufacture of goods industries showed the highest risks. In both sexes, hotel and restaurant workers presented an excess of lung cancer mortality. CONCLUSION: Most of the activities and occupations in which we observed excess lung cancer mortality have previously been observed to involve occupational exposure to lung carcinogens. These findings suggest that the number of occupational lung cancer is likely underestimated by the official Swiss statistics. Further research should address this question and the exposure-effect relationships in the most at-risk occupational groups

**Bresemi I, Folgori L, and De Bartolo P. Interventions to reduce occupational stress and burn out within neonatal intensive care units: a systematic review. Occupational and Environmental Medicine. 2020; 77(8):515-519.**

<https://doi.org/10.1136/oemed-2019-106256>

Abstract: Occupational stress is an emerging problem among physician and nurses, and those working in intensive care settings are particularly exposed to the risk of developing burnout. To verify what types of interventions to manage occupational stress and burn out within neonatal intensive care units (NICUs) have been introduced so far and to verify their efficacy among caregivers. PsycINFO (PsycINFO 1967-July week 3 2019), Embase (Embase 1996-2019 week 29) e Medline (Ovid MEDLINE(R) without revisions 1996-July week 2 2019) were systematically searched combining MeSH and free text terms for "burn out" AND "healthcare provider" AND "NICU". Inclusion criteria were interventions directed to healthcare providers settled in NICUs. Only English language papers

were included. Six articles were included in the final analysis. All the studies reported an overall efficacy of the interventions in reducing work-related stress, both when individual focused and organisation directed. The analysis revealed low quality of the studies and high heterogeneity in terms of study design, included populations, interventions and their evaluation assessment. There is currently very limited evidence regarding the management of occupational stress and burn out within NICUs. The quality of available studies was suboptimal. The peculiarities of the NICUs should be considered when developing strategies for occupational stress management. Training self-awareness of workers regarding their reactions to the NICU environment, also from the pre-employment stage, could be an additional approach to prevent and manage stress

**De Breij S, Macken J, Qvist JY, Holman D, Hess M, Huisman M, et al. Educational differences in the influence of health on early work exit among older workers. Occupational and Environmental Medicine. 2020; 77(8):568-575.**

<https://doi.org/10.1136/oemed-2019-106253> [open access]

Abstract: OBJECTIVES: Previous research has shown that poor physical and mental health are important risk factors for early work exit. We examined potential differences in this association in older workers (50+) across educational levels. METHODS: Coordinated analyses were carried out in longitudinal data sets from four European countries: the Netherlands (Longitudinal Aging Study Amsterdam), Denmark (Danish Longitudinal Study of Ageing), England (English Longitudinal Study of Ageing) and Germany (German Ageing Survey). The effect of poor self-rated health (SRH), functional limitations and depression on different types of early work exit (early retirement, economic inactivity, disability and unemployment) was examined using Cox regression analysis. We examined educational differences in these effects by testing interaction terms. RESULTS: Poor physical and mental health were more common among the lower educated. Poor SRH, functional limitations, and depression were all associated with a higher risk of early work exit. These health effects were strongest for the disability exit routes (poor SRH: HRs 5.77 to 8.14; functional limitations: HRs 6.65 to 10.42; depression: HRs 3.30 to 5.56). In the Netherlands (functional limitations) and England (functional limitations and SRH),

effects were stronger in the lower educated. **CONCLUSIONS:** The prevalence of health problems, that is, poor SRH, functional limitations and depression, was higher in the lower educated workers. All three health indicators increase the risk of early work exit. In some countries, health effects on early exit were stronger in the lower educated. Thus, lower educated older workers are an important target group for health policy and intervention

**Hecker S. Hazard pay for COVID-19? Yes, but it's not a substitute for a living wage and enforceable worker protections. *New Solutions*. 2020; 30(2):95-101.**

<https://doi.org/10.1177/1048291120933814>

Abstract: The COVID-19 pandemic is exposing critical failures in public and occupational health in the United States. So-called hazard pay for essential workers is a necessary but insufficient response to the lack of workplace protections. The roots of these failures in the weakening of the Occupational Safety and Health Administration enforcement and pandemic preparedness and the dramatic shifts in the economy and labor market in recent decades are explored along with the history of hazard pay. The current prominence of COVID-19-related workplace hazards, and the mobilization by both nonunion and union workers experiencing them, presents opportunities amid the crisis and tragic losses to envision a revival of worker protection measures. Strategies are needed for organizing and legislative advocacy to address the disparate impact of both normal and crisis conditions on low-wage workers, especially women and workers of color

**Kreiner DS, Matz P, Bono CM, Cho CH, Easa JE, Ghiselli G, et al. Guideline summary review: an evidence-based clinical guideline for the diagnosis and treatment of low back pain. *Spine Journal*. 2020; 20(7):998-1024.**

<https://doi.org/10.1016/j.spinee.2020.04.006>

Abstract: **BACKGROUND CONTEXT:** The North American Spine Society's (NASS) Evidence Based Clinical Guideline for the Diagnosis and Treatment of Low Back Pain features evidence-based recommendations for diagnosing and treating adult patients with nonspecific low back pain. The guideline is intended to reflect contemporary treatment concepts for nonspecific low back pain as



reflected in the highest quality clinical literature available on this subject as of February 2016. **PURPOSE:** The purpose of the guideline is to provide an evidence-based educational tool to assist spine specialists when making clinical decisions for adult patients with nonspecific low back pain. This article provides a brief summary of the evidence-based guideline recommendations for diagnosing and treating patients with this condition. **STUDY DESIGN:** This is a guideline summary review. **METHODS:** This guideline is the product of the Low Back Pain Work Group of NASS' Evidence-Based Clinical Guideline Development Committee. The methods used to develop this guideline are detailed in the complete guideline and technical report available on the NASS website. In brief, a multidisciplinary work group of spine care specialists convened to identify clinical questions to address in the guideline. The literature search strategy was developed in consultation with medical librarians. Upon completion of the systematic literature search, evidence relevant to the clinical questions posed in the guideline was reviewed. Work group members utilized NASS evidentiary table templates to summarize study conclusions, identify study strengths and weaknesses, and assign levels of evidence. Work group members participated in webcasts and in-person recommendation meetings to update and formulate evidence-based recommendations and incorporate expert opinion when necessary. The draft guideline was submitted to an internal and external peer review process and ultimately approved by the NASS Board of Directors. **RESULTS:** Eighty-two clinical questions were addressed, and the answers are summarized in this article. The respective recommendations were graded according to the levels of evidence of the supporting literature. **CONCLUSIONS:** The evidence-based clinical guideline has been created using techniques of evidence-based medicine and best available evidence to aid practitioners in the diagnosis and treatment of adult patients with nonspecific low back pain. The entire guideline document, including the evidentiary tables, literature search parameters, literature attrition flowchart, suggestions for future research, and all of the references, is available electronically on the NASS website at <https://www.spine.org/ResearchClinicalCare/QualityImprovement/ClinicalGuidelines.aspx>

**Maung Z and Tustin AW. The heat death line: proposed heat index alert threshold for preventing heat-related fatalities in the civilian workforce. *New Solutions*. 2020; 30(2):138-145.**

<https://doi.org/10.1177/1048291120933819>

Abstract: A threshold Heat Index (HI) can serve as the basis for advising the civilian workforce about the risk of heat-related illnesses. We conducted a systematic review and compiled reports of work-related fatalities from heat-related illnesses. We calculated the HI for each fatality. Our objective was to expand upon the military's concept of a "heat death line" and identify an HI alert threshold for the civilian workforce. We identified 14 publications totaling 570 heat-related deaths. In the meta-analysis, the median HI was 101 with a range of 62 to 137. Almost all deaths (96 percent and 99 percent of civilian and military fatalities, respectively) occurred when  $HI \geq 80$ , which is our proposed heat death line. Some existing HI-based heat advisories are set at a higher temperature value. However, many occupational heat-related illnesses occur below these thresholds, resulting in low sensitivity and a false sense of security. In at-risk outdoor industries,  $HI \geq 80$  should trigger hazard awareness and protective actions.

**Ranka S, Quigley J, and Hussain T. Behaviour of occupational health services during the COVID-19 pandemic. *Occupational Medicine*. 2020; 70(5):359-363.**

<https://doi.org/10.1093/occmed/kqaa085> [open access]

Abstract: BACKGROUND: Disasters, crises and pandemics are emergencies which impact on businesses severely. The COVID-19 pandemic reached its peak in mid-April 2020 in the UK. During this period, NHS Occupational Health Services (OHS) were stretched to their limit along with other health services. OHS may have had to change their pattern of operation, operating times, services offered, etc. to cope with the pandemic. Data about business model modifications, services offered by the OHS businesses during the pandemic could help in better utilization of OHS resources in the future. AIMS: To understand the behaviour of OHS in different parts of the country during the COVID-19 pandemic. METHODS: An online survey link was sent to both accredited and unaccredited UK Occupational Health Physicians (OHPs). RESULTS: Sixty-two OHPs responded to the survey. In the current pandemic, 51% of the OHS

(95% CI 0.38-0.62) offered weekend or out-of-hours (OOH) services, 21% had to employ extra staff (95% CI 0.13-0.33) and 54% had to change their working hours (95% CI 0.41-0.65). Ninety per cent of the OHS (95% CI 0.78-0.94) continued to offer routine services; however, there was a decline in offering vaccination services. Fifty-six per cent of the OHS (95% CI 0.42-0.67) offered a dedicated telephone line and 46% of the OHS (95% CI 0.32-0.56) started a dedicated COVID-19 queries inbox. CONCLUSIONS: There was a change in the behaviour of the OHS to cope with the pandemic. Having a dedicated helpline to manage the crisis situation seemed a logical step whilst offering routine services

**Roycroft M, Wilkes D, Pattani S, Fleming S, and Olsson-Brown A. Limiting moral injury in healthcare professionals during the COVID-19 pandemic. Occupational Medicine. 2020; 70(5):312-314.**

<https://doi.org/10.1093/occmed/kqaa087> [open access]

**Savitsky B, Radomislensky I, Goldman S, Gitelson N, Frid Z, and Peleg K. Socio-economic disparities and returning to work following an injury. Israel Journal of Health Policy Research. 2020; 9(1):35.**

<https://doi.org/10.1186/s13584-020-00392-3> [open access]

Abstract: BACKGROUND: Traumatic injury is one of the main reasons for temporary and permanent occupational disability. The objective of this study was to define the role of socio-economic position on post-injury occupational absenteeism. METHODS: This was a nationwide retrospective cohort study, based on linking The Israeli National Trauma Registry (INTR) and the National Insurance Institute (NII) databases. The study population included 44,740 injured workers (residents of Israel, aged 21-67, hospitalized between 2008 and 2013 and employed prior to injury as salaried workers). Logistic-regression models tested the probability of not returning to work (RTW). RESULTS: The majority of the study population (61%) RTW within 1 month following the injury event. Income prior to injury was significantly associated with longer out of work stay, explaining 9% variance. A significant interaction ( $p$  value  $<0.0001$ ) was found between age and income on out of work stay more than 1 month, 1 year and 2 years. Logistic regression models of out of work stay were

conducted separately for all age groups. Lower income was associated with greater chance for out of work stay for more than 1 month; and the gap between the lowest and highest income quartiles was greater among older workers (age 55+), where there was an elevenfold increase in probability of not RTW among casualties from the lowest vs. highest income quartile. In comparison to other population groups, Arabs were at greater odds of longer out of work stay following an injury. Among injured persons recognized by the NII as having occupational injuries, the odds for not RTW within a month, a year and 2 years were respectively 3.9, 2.5 and 2.2 times significantly greater in comparison to employees injured outside the workplace. CONCLUSIONS: This study identified population groups with a high probability of not RTW following an injury requiring hospitalization. Intervention programs for injured employees should promote early rehabilitation and aim to shorten out of work stay. These programs should be ethnically adapted and focus on underprivileged and disadvantaged populations

**Swanton A, Peek-Asa C, and Torner J. Time to definitive care among severely injured farmers compared to other work-related injuries in a Midwestern state. International Journal of Epidemiology. 2020; 7(1):33.**

<https://doi.org/10.1186/s40621-020-00259-w> [open access]

Abstract: Background: Farming is a high risk occupation that predisposes workers to injury, but may also lead to barriers in reaching trauma care. Little is known about emergency and trauma care for patients with farm-related injuries. The purpose of this study was to determine whether severely injured farmers presenting to a statewide trauma system faced delays in reaching definitive care compared to other severely injured workers. Methods: A population-based observational study was performed using the Iowa State Trauma Registry from 2005 to 2011. The registry was used to identify a multiply imputed sample of severe occupational injuries. Time to definitive care for farm- and non-farm-related injuries was compared using Kaplan-Meier curves and an extended, stratified Cox model censoring at 4 h. An interaction with time was included in the Cox model to generate hazard ratios for each hour after injury. Results: Seven-hundred forty-eight severe occupational injuries were identified; 21% of these were farm-related. The overall median time to

definitive care was nearly an hour longer for farmers compared to other workers (2h46m vs. 1h48m,  $p < 0.05$ ). When adjusted for confounders, farm status remained a significant predictor of delay in reaching definitive care, but only in the first hour after injury (HR = 0.44, 95%CI = 0.24-0.83). Conclusions: Farm-related injuries accounted for more than 1 of every 5 severe occupational injuries entered into the Iowa trauma system. We found that severely injured farmers had delays in reaching definitive trauma care, even when adjusted for confounding variables such as rurality. This effect was most pronounced in the first hour.

**Thompson CJ, Gwernan-Jones R, Garside R, Nunns M, Shaw L, Melendez-Torres GJ, et al. Developing methods for the overarching synthesis of quantitative and qualitative evidence: the interweave synthesis approach. Research Synthesis Methods. 2020; 11(4):507-521.**

<https://doi.org/10.1002/jrsm.1383>

Abstract: The incorporation of evidence derived from multiple research designs into one single synthesis can enhance the utility of systematic reviews making them more worthwhile, useful, and insightful. Methodological guidance for mixed-methods synthesis continues to emerge and evolve but broadly involves a sequential, parallel, or convergent approach according to the degree of independence between individual syntheses before they are combined. We present two case studies in which we used novel and innovative methods to draw together the findings from individual but related quantitative and qualitative syntheses to aid interpretation of the overall evidence base. Our approach moved beyond making a choice between parallel, sequential, or convergent methods to interweave the findings of individual reviews and offers three key innovations to mixed-methods synthesis methods: The use of intersubjective questions to understand the findings of the individual reviews through different lenses, Immersion of key reviewers in the entirety of the evidence base, and Commencing the process during the final stages of the synthesis of individual reviews, at a point where reviewers are developing an understanding of initial findings. Underlying our approach is the process of exploration and identification of links between and across review findings, an approach that is fundamental to all evidence syntheses but usually

occurs at the level of the study. Adapting existing methods for exploring and identifying patterns and links between and across studies to interweave the findings between and across reviews may prove valuable

\*IWH Authored publications.