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Abstract

Background: In the UK, increasing numbers of paid employees are over 60 years with further increases expected as the state pension age rises. Some concern surrounds possible increased work-related illness and accidents for people working beyond the age of 60.

Aims: To identify the available evidence for health and safety risks of workers over age 60 years with respect to factors associated with injuries and accidents.

Methods: Databases searched included PUBMED, OSHUpdate, National Institute for Occupational Safety and Health (NIOSHTIC-2), SafetyLit, the UK The Health and Safety Executive (HSELINE) and the Canadian Centre for Occupational Health and Safety until December 2009. Inclusion criteria were workers aged over 60 years. Findings were grouped into occupational accidents and injuries and individual and workplace factors that may have influenced risk of injury to the over-60s.

Results: Very little direct evidence was found concerning safety practices and health risks of workers over age 60. Some safety risks were associated with specific physical declines such as age-related hearing loss. Overall, these workers had fewer accidents and injuries but these were more likely to be serious or fatal when they occurred. There was no strong evidence that work patterns, including shift work or overtime, affected safety. Protective, compensatory strategies or experience may maintain safe working practices.

Conclusions: Implications for health and safety risks cannot be assessed without longitudinal research on workforces with substantial numbers of workers over age 60 in order to address the healthy worker effect.

Key words: Accident, health and safety, injury, older worker

Introduction

In the UK, there are increasing numbers of paid employees over age 60 and further increases are inevitable as the government raises the pension age. Workers approaching and past traditional retirement age (60–65 years) are now the fastest growing age group within the population. In May 2008, employment levels for this age group increased to 1.3 million. The Office for National Statistics (September 2010) reported a considerable increase in people working beyond 65 years of age. In June 2010, in the UK, 823 000 were taking this option. Since 2006, UK legislation has prohibited age discrimination in the workplace enabling workers to request continuation at work when previously they could have been forced to retire most likely leading to further increases in the numbers of over-60s and over-65s remaining at work. In the UK, the state pension age for women is rising from 60 to 65 to equalize with that of men. The Pensions Bill is bringing forward the timing of equal pension ages to November 2018, with a further change in state pension age from 65 to 66 years for both men and women by April 2020.

A UK study showed that those working beyond the state pension age had specific characteristics, including higher education levels and better health, compared with their retired counterparts [1]. A Department of Trade and Industry review [2] presented evidence to suggest that physical or mental decline associated with normal ageing seldom impacted on performance in most work, until age 70, with the exception of jobs requiring fast reactions or physical strength [3]. Research also suggests that the brains of older adults may function differently from younger adults but not necessarily with reduced functioning [4,5]. However, there remains some concern that increased work-related illness and accidents may occur in those working after age 60. Topics raised in association with workplace accidents include mobility, strength, dexterity and balance; sensory losses including hearing and vision; and cognitive changes with slower information processing and delayed reaction times [6]. These changes may increase the risk and severity of accidents. However, results of such research on physical, cognitive and sensory changes in older people who are not necessarily employed may not be applicable or predictive of changes in workers over age 60. This systematic review explores the current evidence for health and safety risks in workers over age 60 with respect to injuries and accidents.

Methods

There is no consistent definition of an ‘older worker’ in published research. ‘Older worker’ has been defined as 40-plus [7] and as aged 50 years or older [8]. The US Department of Labor uses >40 years in some statistics, and several Bureau of Labor Statistics (BLS) stratifications use >45 years for reporting injury and illness. The US Office of Aging describes older ‘citizens’ as older than 55 years. The United Nations recognizes the older worker group as 60 years or older [9]. The Labour Force Survey reports injury risks for workers in the oldest age group between 55 and 59 while the Health and Safety Laboratory Report reviews research on ‘older workers’ as those over age 50 [10]. Studies of older workers frequently indicate 59 years as an upper limit although as often the age category is stated as ‘over 55’, with no further age breakdown. This review sought primary research that included data from employed participants aged 60 years and above, therefore contributing to the evidence base about relationships between age and safety at work.

Databases searched were PUBMED, MEDLINE, OSHROM, OSHUpdate, the National Institute for Occupational Safety and Health (NIOSHTIC-2), the Health and Safety Executive (HSELINE) and the Canadian Centre for Occupational Health and Safety for relevant primary research. The search process is illustrated with one PUBMED database search strategy. Limits were English language, humans AND all adult 19+ years AND 1995–2009. Exclusions were agriculture studies (workers largely being self-employed), and Asian and Far East research where attitudes to older workers may differ from Western countries. Key words for locating potentially relevant research were ageing OR older worker OR elder worker OR older employee OR post-retirement worker AND one of the following: ‘health AND safety’ (N = 55), ‘Safety’ (N = 41), ‘Accident’ (N = 35) and ‘Occupational injury’ (N = 286). This process was repeated with the other databases. Empirical studies were critically examined and excluded where there was no further analysis with respect to occupational injury and/or accident rates, for the over age 60-year age group. Further references were identified from bibliographies. A system was not used for assessing the level of evidence but strengths and limitations are discussed briefly for each study, in particular with reference to study design.

Results

Thirty-six studies were assessed as being suitable for inclusion in this systematic review. Findings were grouped into occupational accidents and injuries and individual and workplace factors that may have influenced risk of injury to the over-60s.

Occupational injury, accidents, sick leave and fatalities

Laflamme et al. [11] analysed data from a 10-year longitudinal register study of Swedish iron ore miners. The oldest age group, 55–65, comprised 1% of the sample and had fewer accidents than the younger age groups, but more severe injuries leading to more days off work. In Ireland, injuries, diseases and disabilities in relation to sickness absence leading to early retirement were studied in a population of 18- to 64-year-old male construction workers [12]. Between 1972 and mid-1996, there were 28 792 records of sickness absence and 3098 of early retirement. In 1996, the rate of absence per 100 workers for the 60–64 age group was 13.3 compared with 4.5 for workers aged 20–29 years. Of the 15 682 known causes of sickness absence, however, 6% (n = 916) were in the 60–64 age group compared with 18% in the 50–59 age group and 23% in the 40–49 age group (all % figures rounded). The most frequent categories of sickness absence were injuries (30%), infectious diseases (25%) and musculoskeletal problems (13%). Injury in those aged 60–64 years was lower, affecting 16% compared with 21% in the 50–59 group and 42% for those aged 20–29 years. Details of hours worked in the different age groups, however, were not available.

A different pattern was observed in a study that included workers aged ≥65 years, using data from several large-scale national US surveys [13]. Sickness absence following work injury increased in each decade, with a median of 5 days for those aged 20–24 years and 18 days for those aged ≥65 years. Workers over 65 were at particular risk from injuries associated with transportation/driving and had more disabling fracture injuries compared with younger workers. Reported injuries were not limited to ‘dangerous’ jobs, driving or heavy manual work, retail sales having the highest rate of same-level falls for the 65+ age group. An incidence study of US national data for 1993 (91 932 100 employed civilians) reported that financial costs for non-fatal injuries were highest for the 25- to 34-year olds and lowest for those

aged 17 years and younger. For fatal injuries, the highest costs (58.8%) were for the youngest; at ages 55–64, this was 25% and for the over-65s was 33% [14].

Fatal workplace accidents were reported from the US National Traumatic Occupational Fatalities surveillance system from 1980 to 1994 [15]. Workers ≥65 had 6 471 fatalities (13.7 per 100 000 workers), a rate almost three times higher than for workers aged 16–64 (5.1 per 100 000). The main causes of death for workers in the ≥65 age group were machinery (28%), motor vehicles (19%), falls (13%) and homicide (13%). Machinery-related fatalities for males ≥65 were almost six times greater than the rate for pre-retirement age males. The fatality rate for falls amongst females aged 65 years and over was 14 times that of females aged 16–64 years. The data do not enable clarification as to whether illness (e.g. stroke) contributed to fatal accidents. The Census of Fatal Occupational Injuries, a programme of the US BLS reported on 11 952 work-related highway fatalities in civilian workers between 1992 and 2000 indicating the ≥65 age group had more than three times the fatality risk of workers of all ages [16].

Proportional mortality rates for electrocutions in the US construction industry between 2004 and 2006 calculated from the US BLS data indicated younger workers were more likely to die from contact with overhead power cables while workers >65 were more likely to die from touching electrical wiring and transformers. These differences may reflect the different types of work performed by people in the various age groups, rather than age [17].

Individual factors associated with workplace accidents and injuries

Physical capacity of older workers

There was limited primary research into the physical/functional status of workers over age 60. Most studies did not define working status (e.g. [18]), or focused on ‘older workers’ below 60; or had not extracted data from the ≥60-year-old participants. For example, two studies in European countries [19,20] examined musculoskeletal disorders among older female computer workers. While both included over-60s, there was no specific analysis of this age group. Therefore, no inferences can be made from these results about whether over age 60 workers, have either more or fewer musculoskeletal problems, nor whether those affected by these

symptoms have similar or distinctive problems with stress or job demands compared with younger workers.

A US cohort of 18 768 carpenters was studied with respect to work-related back injuries between 1989 and 2003. A significant reduction in the rate of new claims for back injuries was seen amongst 50- to 60-year-olds (average 3.8 claims per 200 000 h worked compared with 9.6 claims by younger workers) with a further reduction in those over age 60 [21]. This evidence is relevant due to large numbers of workers over age 60 in construction. The trend might imply that the oldest workers were a healthier, better functioning group (or that they chose not to claim for back injuries).

A study of 173 occupational injuries amongst cooks and food service workers over a 12-month period in British Columbia found 67% of reported injuries resulted in time lost [22]. The rates for musculoskeletal injury, contusion, burns, irritations and allergies were all lower amongst those over age 60. Study limitations were the small numbers of injuries overall and the small numbers of over-60s (n = 31), resulting in wide confidence intervals.

Hearing loss and occupational risk factors for workers over age 60

Age-related hearing loss (presbycusis) affects approximately 16% of adults aged 20–69 years [23], 23% between 65 and 75 and 40% of those older than age 75 [24]. Hearing loss associated with occupational exposure to noise [25], especially unprotected noise exposure above 85 dBA [26] or 95 dBA [27], may be an additional problem for workers over age 60 alongside the prevalence of presbycusis and increasing risk with any noise exposure over a long working life.

A US longitudinal population-based study of adults aged 48–92 years reported the incidence of hearing loss as 21% at 5-year follow-up [28] and 37% at 10-year follow-up [29]. Age was the main risk factor for incidence and progression. Work and education were risk factors after adjustment for age and male gender. Operators/fabricators had the highest odds ratio (1.92), linked with noisier working environments. Limitations of this longitudinal study included unknown numbers at work at follow-up and uncertain assessment of noise exposure for retired participants. A longer exposure to noise within the workplace and greater hearing

loss was not directly demonstrated by this study, as history of noisy jobs was not associated with the 10-year incidence of hearing impairment.

Results from a UK cross-sectional survey (58% response rate) with workers from age 16 to 64 years supported age-related trends in hearing loss associated with occupational noise exposure for over 12 000 adults [30]. The highest prevalence for severe hearing difficulties was 8% in the oldest age group (55–64 years), associated with lengthy exposure to workplace noise.

Hearing difficulties were self-reported by 11% of a US National Health Interview Survey [31] of more than 130 000 current industrial workers (of whom approximately 10% were aged 55–64 years). While there were no details for those between 60 and 64, rates of hearing difficulties of 22% were found in the 55–64 age group with an adjusted prevalence ratio (PR) of 3.68 (95% CI: 3.37, 4.01) compared with the reference group in the 18–25 age category. After adjustment for age and gender, PRs for hearing difficulty were highest in railroad, mining and metal manufacturer workers. Mechanics, repairers and transportation equipment operators had increased risk. Notwithstanding a large sample size, limitations were cross sectional design, the possibility that industry–occupation categories were not homogenous and no validation of hearing using audiometric tests. Tentatively, these findings suggest that workers aged 55–64 years were at elevated risk of hearing loss, linked both with normal ageing and also occupational noise hazards.

The association between accident risk and workers' hearing sensitivity was addressed in a retrospective Canadian study [32]. A sample of 52 982 male workers (mostly blue-collar), aged 16–64 years, was monitored for 5 years following a hearing test. The number of workplace accidents was determined from work histories registered with the Quebec workers' compensation board between 1983 and 1998. A hearing loss of 20 dB correlated with a 1.14 rise for risk of accident when age and occupational noise exposure at the time of hearing test were taken into account. The strongest association was in the noisiest environments of metal transformation, metal product and transportation equipment manufacturing. Passive accidents and 'same-level falls' were categories most strongly associated with hearing loss. Overall, 12% of accidents were attributed to a combination of noise exposure in the workplace (of 90 dBA or more) and noise-induced hearing loss. However, although

older workers were more likely to have hearing losses, they also had reduced risk of accident possibly associated with greater work experience. Thus, whilst accident rates increased with greater levels of hearing impairment, older age appeared to be protective. Risks of accidents were approximately halved among the oldest group (55+). Limitations included lack of detailed data for the over-60s and difficulty in ascertainment of duration of total noise exposure over a working career.

Results from a large retrospective cohort linked driving records from the Quebec National Institute of Public Health to information on measured occupational noise exposure and a standardized hearing test for 46 030 male workers (ages 16–64) in noisy industries [33]. Occupational noise exposure (≥100 dBA) and even slight noise-induced hearing losses interfered with the safe operation of motor vehicles. Regression analysis indicated that hearing loss (and daily exposure to loud noise in the workplace) was associated with increased risks of accidents and highway code violations. Analysis indicated that the oldest workers (in the category of 55+) had the fewest driving accidents. The relevance of age and accidents for those between 60 and 65, and possible compensatory strategies of older, experienced workers, was not possible to assess with the dataset or data provided in this study.

Visual and other perceptual problems

Occupational injuries among older workers with disabilities (aged 51–61 years) were studied in a prospective cohort of health and retirement [34]. Risk factors measured in 1992 and occupational injuries occurring between 1992 and 1994 were analysed. Odds ratio for self-reported disability was 1.58 (95% CI: 1.14, 2.19) but not significant for poor hearing 1.35(0.95, 1.93) and poor sight 1.45 (0.94, 2.22). These remained risk factors for occupational injury after control for occupation, heavy lifting and self-employment. This study provides some evidence for an association between pre-existing disabilities and subsequent workplace accidents. Study strengths included the large nationally representative sample of 9756 subjects of whom 7089 were employed in the year before the interview and therefore at risk for occupational injury. The 82% participation rate enabled results to be generalized for the US worker population with disabilities up to age 61. Limitations were few workers over age 60 and the potential for recall bias with risk factor and occupational injury data collected in the same questionnaire.

Cognitive functioning

Among those who continue to work, cognitive decrements may affect driving, this task relying on complex sensorimotor integration. Driving performance of commercial truck drivers (with participants aged up to 76) was measured in relation to perceptual, cognitive and psychomotor abilities [35]. Older ages showed decrements in perceptual processing, including loss of visual acuity, reductions in contrast sensitivity and impaired judgement for depth and distance. However, age-related deterioration in driving performance was not as well marked in the over age 50 group, only 8 of 24 measures of driving showing age-related deterioration. For two measures, the older drivers scored 'better'; thus length of driving experience may be compensatory. Driving skills were more closely related to cognitive measures than to chronological age. Decision-making skills were not significantly different for drivers over age 65 and those below age 50. Present research is inadequate to break down the mechanisms underlying the relationship between age and driving/cognitive skill. While Llaneras et al. [35] suggest that 10–15% of the general population aged over 65 years have some cognitive impairments, these figures cannot be generalized for those who voluntarily opt into continuing to work beyond this age.

Bosma et al. (2003) [36] reported on the first longitudinal cohort data of 708 participants from the prospective Maastricht Aging Study [37]. Employees were from a range of organizations in 1998, aged 18–68 years with 51% having a retirement age of 65. Low educational level was related to cognitive decline and speed of information processing decreased after retirement among people in their 60s. Complexity of work with people (but not work with things or data) helped maintain cognitive functioning which was greater in workers who rated their jobs more mentally demanding. Stimulating work may therefore afford workers over the age of 60 some protection from cognitive decline. Study limitations were that retired participants rated mental demands of 'previous' jobs; at baseline, the less educated and those in less demanding jobs tended not to respond and were therefore more likely to be lost at follow-up. Most importantly for this review, a lack of distinct numbers in each age group resulted in unknown numbers of workers over the age of 60.

Taylor et al. [38] investigated the influence of age and aviation expertise on flight simulator performance annually over 3 years in 118 general aviation pilots aged 40–69 years. Older pilots showed less reduction in overall flight performance than younger pilots. These longitudinal findings suggest advantages of experience and expertise on older adults' skilled cognitive performances. At baseline, however, age differences were seen showing older pilots to be less accurate in following flight control instructions.

Job and workplace variables

Shift work

Professional pilots have some of the highest demands for physical and mental abilities involving shift work. The International Civil Aviation Organization has implemented regulatory measures to manage some risks associated with ageing including a mandatory retirement age, regular medical assessments for fitness to fly, and limits on the duration of duty. The retirement age was recently increased from 60 to 65 years for one member of a two-person cockpit crew [39]. A study of 558 air carrier accidents attributed 35% of accidents to pilot error but neither crash circumstances nor prevalence and patterns of pilot error changed significantly with age increases from 40s to 50s and into the early 60s [40]. The authors suggest that these results may reflect the 'older' 'safe worker effect' and point out that air carrier pilots are a highly selected occupational group with rigorous screening out of those who are unfit. A case–control study of general aviation accidents in reduced visibility, with pilots aged ≤40 (21%) to over age 60 (33%), initially found a high correlation between pilot age at accident and pilot age at first certification. Further modelling showed age at first certification to be the better predictor with those who received their initial certificate before age 25 showing the lowest risk, suggesting early experience as important [41]. Variables of interest were identified a priori and data for accidents were collected within the accident investigation. Matched control flights with pilot data were collected in the immediate hours following the aircraft incident.

A study of over 3000 male shift workers showed reduced cognitive performance for immediate or short-term memory, but no problems with female shift workers. The 62-

year-olds (14%) were not more or less affected by shift work patterns than younger workers [42]. While trends in workforce demographics indicate that shift work by those of 65 years and older will increase, present research of so-called ‘older’ shift workers involves younger workers of 40–55 years.

With respect to worker compensation for injuries between 1990 and 1997, in Oregon, USA, examination of 7717 claims by hospital employees (age <25 to over 65) suggested there was little difference by age between day, evening and night shifts. The least percentage of claims were in those younger than 25 (8.5%) and those aged 56–65 years (8.7%). Workers over age 65 made only 0.7% of claims [43].

Job stress/demands/overtime

Job stress/workload and demand may increase the likelihood of accidents. The Whitehall II study results found longer exposure to high job strain and shorter exposure to active jobs were associated with lower scores in most cognitive performance tests in later phases of the project [44]. Job categories were based on the demand-control model: high-strain jobs had low control and high demands and active jobs had high control and high demands. There was no consistent support for job strain as a determinant of cognitive function. While some participants were over 60, the mean age of 54.8 years meant that implications are unclear for those workers over age 60.

Secondary analyses of longitudinal data for 2746 workers at US heavy manufacturing sites during 2001–2002 calculated the effects of overtime on employee health, safety and productivity and compared older with younger workers [45]. The 5-year age bands between age 30 and 65 included 174 workers in the 60–64 age group and 27 over age 65. As in many other studies, for meaningful analysis, the upper age bands were collapsed into age 50 and over, leaving implications for the over-60s uncertain. Older age was associated with higher rates of some adverse outcomes with respect to overtime, but these were confined mainly to hourly employees averaging 60+ h per week. For moderate overtime (48–60 h), older age was not associated with worse health outcomes. In many cases, older workers had a decreased likelihood of injuries. But the evidence cannot be generalized with confidence to those working beyond the age of 60 or 65 as small numbers were analysed, with crude age categories, and potential confounders neglected.

Conclusions

This review found relatively little research considering workers over the age of 60 and only six papers were found with participants working beyond age 65. While some research for those over age 60 reported higher rates of accident and injury, others presented lower rates when compared with younger workers. In some, compensatory strategies linked with greater job experience or expertise, appeared as protective (e.g. maintaining driving safety). Job experience may therefore confound work injuries and fatalities that appear to be associated with age. On the other hand, job experience may be acting as a covariate with age. Workers over age 60 may also face different risks, relating to specific job tasks, as noted among the electrical workforce. The number of hours worked, time of the accident, role of illness (e.g. stroke) or medication, and specific environmental factors (e.g. weather) were usually not available for analysis. If workers are part-time (common among the over-60s) [1], injury rates based on a denominator of worker numbers (instead of hours worked) may in fact underestimate risk of injury. When accidents occurred, workers over age 60 were more seriously affected, requiring more time off.

Whilst the older population in general tends to show cognitive decline with advancing years, workers over age 60 may be a self-selected group with well-preserved cognitive functioning. Little evidence exists showing cognitive changes affecting job performance or safety in the over-60 worker, although mixed outcomes are seen for driving safety. There was evidence that older people are vulnerable to hearing loss and that as little as 1-year exposure to noisy working environments increased this risk [33]. While no direct evidence indicated the levels of hearing impairment among workers over age 60, arguably older workers should undergo regular hearing assessment and avoid noisy environments that may exacerbate ‘normal’ age-related hearing loss. There is evidence that hearing impairment increases risks of accidents/injuries at work [32]. However, no study on noise and accidents focused on older workers who opted to work beyond the present state retirement age. Another major limitation was lack of measurement of noise exposure using objective noise monitoring rather than work histories. Exacerbation of age-related hearing loss through working in noisy environments has implications for both general practitioners and occupational physicians [46]. There is no robust evidence that work patterns, including shift work or overtime (unless excessive at over 60 h per week), affected

the safety of the 60+ year old worker, more than workers in their 50s. Overall, the evidence we found suggests that workers aged over 60 cope well with their work and the stresses of job demands.

We found no explicit research data that included analysis of workers over age 60 and specific workplace factors associated with injury or accident. The lack of age-specific injury and illness data by job title or other exposures prevents the discussion of factors that will enable workers to remain safely in work into their late 60s or beyond, an important issue as the state pension age in the UK will increase to 66 years in 2018.

Specific evidence about people working into their 60s and beyond is limited as analyses often recoded data into an oldest age category (e.g. 'age 55-plus' workers), even when workers in their 60s were included in the study. Workers in their late-50s might regard retirement as distant and may have different attitudes, abilities and other characteristics compared with workers opting to stay up to and beyond their 60s. The prevalent recourse to part-time working among the over-60s [47] might have positive implications for health and safety but these have not been examined. Those who choose to work beyond the age of 60 or 65 may have higher levels of cognitive resource. Whilst older age may be generally associated with higher risks of disease and impairment (e.g. musculoskeletal problems, heart disease or obesity), those employed over the age of 60 may be a self-selected healthier group, representing the healthy worker.

Recommendations for future research

Longitudinal studies documenting age-related changes in work performance of those in their 60s and 70s are needed to address the 'healthy worker' effect that may profoundly influence the safety of these workers. Studies based on recall of exposure have potential bias where older workers are recalling distant events. Details, both psychological and environmental, associated with accidents and injuries in this subgroup of the workforce have not been researched in detail. The 2004 prospective Share survey [48] will follow work, health and other factors to identify some of the hidden issues within the 'healthy worker' effect. To encourage retention of workers over age 60, the variables associated with health and well-being, and any negative working conditions, need to be identified and addressed.

Elucidation of strategies that workers over age 60 use to maintain safe working necessitates detailed qualitative research and mixed-method studies combining objective data such as accident records and levels of compensation alongside self-reports of current risks at work, coping strategies and safety culture. Occupational physicians should be encouraged to be involved in longitudinal studies of the health of those intending to and subsequently working beyond age 60.

This review has uncovered some evidence for workers over the age of 60 but overall suggests relatively little is known about people who work beyond this age. More information is crucial to inform policy, human resource management, training, work scheduling, ergonomics and occupational health. Longitudinal research is needed to address the specific, possibly changing health and safety issues confronting workers who stay on beyond 60, and the influence of protective resources such as work experience and seniority of status at work.

Key points

- There is almost no explicit research data with analysis of workers over age 65 and workplace factors associated with injury or accident.
- For all ages, there is evidence that hearing impairment increases risks of accidents and injuries at work.
- There is evidence that workers over 60 have excellent safety records in some areas of employment, but where accidents occur they are more likely to be serious.
- There is no robust evidence that work patterns (shift work, or overtime) adversely affect the safety of the over 60-year-old worker, more than workers in their 50s.
- Education and work experience may be protective for workers aged 60 and above.
- As hearing loss seems associated with passive accidents and same level falls, older workers should undergo regular hearing assessment as a precautionary measure and avoid noisy environments that may exacerbate ‘normal’ age-related hearing loss.

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