

INJURY BULLETIN

Queensland Injury Surveillance Unit

No 97 August 2007

QISU collects and analyses data from emergency department injury presentations on behalf of Queensland Health. Participating hospitals represent three distinct areas of Queensland.

QISU publications and data are available on request for research, prevention and education activities.

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Mater Children's, Mater Adult, Princess Alexandra, Redland, Logan, Royal Children's, Queen Elizabeth II, Mount Isa, Mackay Base, Mackay Mater, Proserpine, Sarina, Clermont, Dysart, Moranbah and Mareeba.

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Mining Injuries

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- 97% of people presenting with mining related injuries are male
- The majority of injuries involve hands /fingers or eyes
- One third of all injuries are machinery related
- More than three quarters of presentations are for low acuity injuries
- High acuity injuries are more likely to present in the early morning

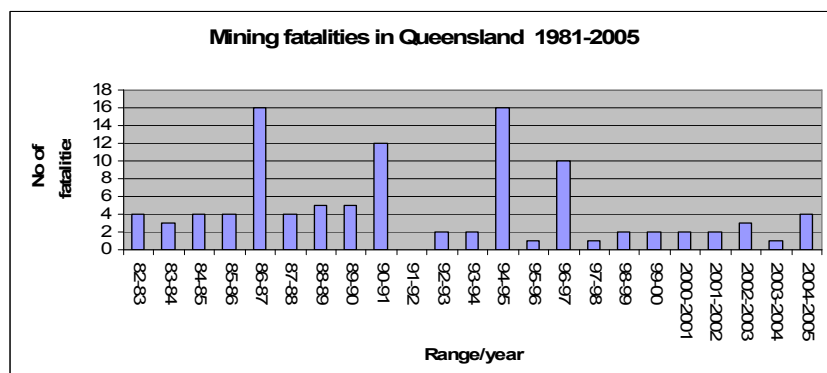
Introduction

Mining is the single largest employment industry in Queensland, contributing 12.4% to the total state income and employing around 20,000 workers per year. It incorporates a variety of mine types including coal and metalliferous mining (both underground and surface mines), and quarries.

Serious incidents are infrequent but devastating if they occur. Minor injuries are, however, common. This issue of the bulletin describes the pattern of mining injuries in Queensland.

Methods

Death data were obtained from the Queensland Government website⁽⁷⁾. **QISU Data** were collected from participating Queensland Emergency Departments (ED) servicing approximately one quarter of the Queensland population. QISU collection sites include key mining populations. Relevant QISU data were identified by searching the QISU database for mining injuries, for the eight year period from 1998-2005.



Graph1. Mining fatalities in Queensland 1981 - 2005
(www.nrm.qld.gov.au/minesafety_health_publications)

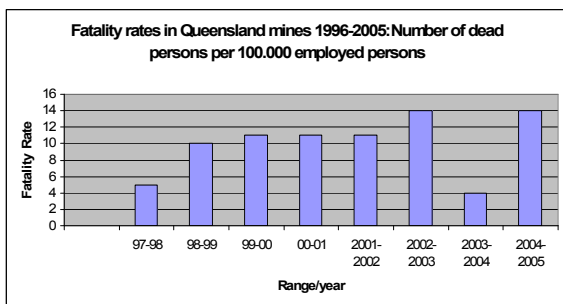
Results

Death Data

Graph 1 shows the number of persons dying in Queensland mines annually, as reported by the Queensland government for the period 1981 to 2005. The graph demonstrates 3 peaks on a steady background number of 1 to 4 deaths annually. The number of fatalities in a year is influenced by single major incidences that cause multiple fatalities like the 1994 Gas explosion in Moura which resulted in the death of 12 mine workers. In some years, several separate incidents have dramatically elevated the number of deaths.

The total number of people employed in the mining industry also shows variation from year to year. The fatality rate (fatally injured persons per 100,000 employed mine workers in Queensland) was calculated for the period 1997 to 2005 based on Queensland Government estimates of mining workforce populations annually (graph 2). Background fatality rates are estimated to be an average of 8/100,000 with rates fluctuating between 4 and 14 deaths per/100,000 workers /year⁽⁷⁾.

Graph 2: Fatality rate expressed as number of mine workers fatally injured per 100,000 mine workers



QISU data

Between 1998 and 2005, 5,772 persons presented to a QISU participating ED following an injury that occurred whilst visiting a mine or being employed by the mining industry.

Gender

The vast majority of injured persons were male (5622 or 97%), and 150 or 3% were female. The majority of women injured (52 or 35%) worked in clerical / domestic duties with proportionally more injured men working as miners (2058 or 37%) or in trade (2510 or 43%). Graph 3 shows the

distribution by occupational category of injured males and females. The rate is expressed as a proportion of injured males or females working in each occupational category.

Graph 3: Distribution of injured persons according to gender and occupational category, Queensland, 1998 to 2005.



Age

The age distribution of injured persons in our series reflects the age of the mining work force with few injuries occurring to workers over 55 and a decreasing trend in injury numbers over 40 years of age. The majority of males injured in mining related work were 25-29 years of age (18% or 1016 males) followed by 30-34 years old (17% or 998 males). Injured female workers showed a similar age distribution.

Injury pattern

The mechanism of mine related injury is complex and multifactorial. The pattern of injury is best described by grouping injuries under the following categories.

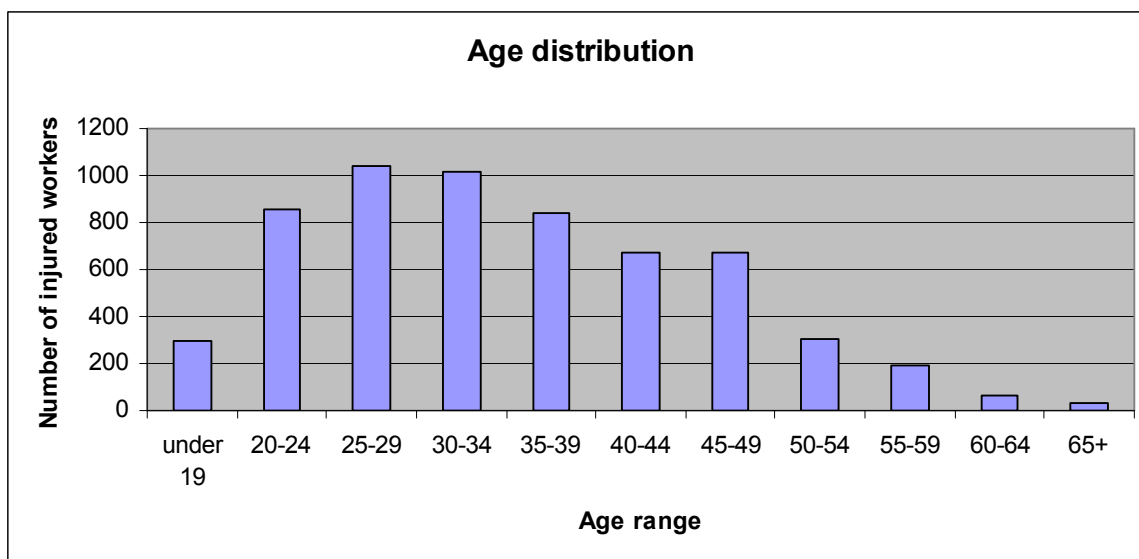
Machinery

Nearly one third of all mining injuries were machinery related (1662). This group includes fixed plant machinery, mobile machinery and power tools. Injury associated with operation of power tools accounted for 545 (33%) of all machinery related injuries. Grinders were the most common power tool associated with injury accounting for 338 machinery related injuries (21%). Mobile machinery accounted for 286 (17%) of machinery related injuries, 223 injuries (14%) were sustained whilst working with welding equipment and 133 injuries (8%) were associated with fixed plant equipment.

Vehicle

Around 11% of all mining injuries (604/5,772) were associated with operating a vehicle. Heavy vehicles such as trucks and mining vehicles were associated with half of these injury presentations (312/604),

Graph 4: Distribution of all injury presentations according to age group (male and female combined) 1998-2005.



cars were associated with 128 injuries (21%) and forklifts with 26 injuries (4%).

Tools

Approximately 6% of all injury presentations (322) were associated with the use of a tool. This group includes equipment such as scaffolding and ladders (which accounted for 30 injury presentations), and hand tools. The most common hand tool associated with injury was a hammer (138/322 or 43%) followed by a knife (77/322 or 24%).

Falls

Approximately 8% of all injuries (482/5,772) were associated with falls. Some falls were from trucks or other machinery /equipment and will also have been included in the categories above. The majority of falls were low falls with 242 (50%) of all falls due to stumbling/ slipping on the same level and 85 (18%) due to falls less than 1 metre. Approximately 23% of falls (111) were from a height greater than 1 metre.

Burns

Approximately 4% or 226 of injuries were burns that occurred after exposure to noxious or hot fumes, liquids or objects. One third of all burns were associated with chemical exposure (80/226) and 32 were associated with contact with hot metal (14%).

Electrical injury

Approximately 3% of injuries (160) were due to electrical injury. Altogether, one half of all electrical injuries were associated

with electrical fixtures (53/160 or 33%) or a variety of power tools (33/160 or 21%).

Other or unspecified

A significant proportion of mining injury presentations (955 or 17%) were for pain with no clear mechanism of injury. Injury patterns in this group include eye irritation and general aches and pains with no clear precipitant. This pattern of injury is likely to be occupation related but difficult to explain in any of the categories above. These are significant in terms of assessing morbidity associated with mine work, but are difficult to categorize in terms of injury causes. Chronic problems such as depression or psychological stress/injury may impact on morbidity in the mining industry but these factors are poorly identified in our data.

Of these presentations 190 (20%) were due to eye irritation and 235 (25%) were due to back, knee or shoulder pain, without a clear associated injury.

Injured body part

About half of all mining related injuries involved eyes or hands. Overall, 26% (1507) of presentations were for eye injuries, and 25% (1467) were for hand injuries. Women had proportionally fewer eye injuries than men (18% compared to 26%).

The majority of eye injuries occurred due to contact with an object or foreign body in the eye (1025/1507 cases or 68%). A significant proportion (286 injuries or 19%) occurred as

a result of a welding flash. The remainder of injuries were due to exposure to noxious substances or heat (90 or 6%) and unknown or unspecified cause (190 or 13%) as discussed above. Of all hand injuries, 982 /1467 (67%) were due to a crushing/ piercing injury, 318 (22%) occurred after a hand was struck by an object and 47 (3%) were due to burns.

Acuity

The vast majority of injuries were of low acuity. Triage categories reflect the medical urgency of the presentation. Triage Category (TC) 1 requires immediate attention and TC 5 within 2 hours. Eight males and no females presented as TC1, and 112 males and 6 females presented as TC2. Overall, only 2% of all presentations required immediate/urgent attention (TC 1 or 2). Of the TC 1 patients one had significant burns, two were involved in MVA's and five encountered life threatening crush injuries while being trapped between heavy objects, under soil or rocks. All patients in this category were admitted to a medical facility.

The patients presenting with TC 2 are describes as follows: Nineteen presented after they sustained life threatening crush injuries to vital organs including chest and pelvis. Fifteen had eye injuries of varying cause, usually associated with significant pain. Thirteen presented with complete or partial amputations of limbs. Twelve were involved in motor vehicle crashes and ten had obtained significant head injuries. Nine

had significant burns and nine were suspected of having significant spinal trauma. Nine presented with limb fractures. Six attended as a result of an electrocution, six after an inhalation of noxious fumes and six after they had sustained a snake bite. Four presented as a result of an allergy, two of those as a result of a wasp sting, two with clinical symptoms of an allergy without obvious eliciting cause.

The six females who presented as triage category 2 patients had similar injuries to the men. Two presented following falls. The remaining four presented with the following injuries; being stung by wasps, snake bite, acid burn to eye and motor vehicle crash (lost control of dozer and went over mine wall).

Of all TC 2 patients, 70/118 or 60% were admitted, 9/118 or 7% were transferred and 39/118 or 33% were discharged.

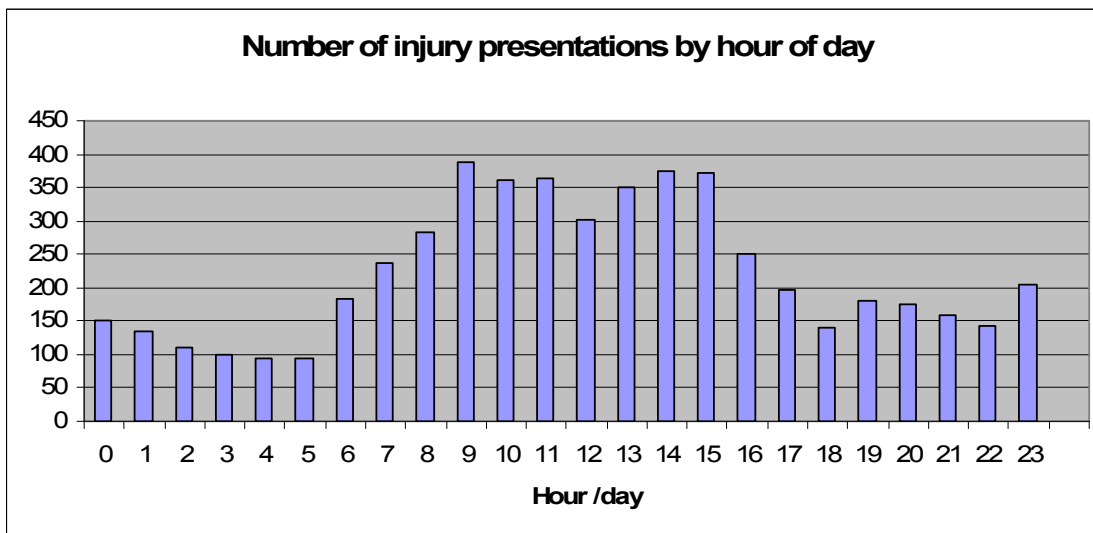
Overall 85% of all injured persons were discharged from hospital (85% or 4740 males, 84% or 124 females). Around 13% were admitted or transferred (14% or 764 of males and 13% or 19 females).

Time of presentation

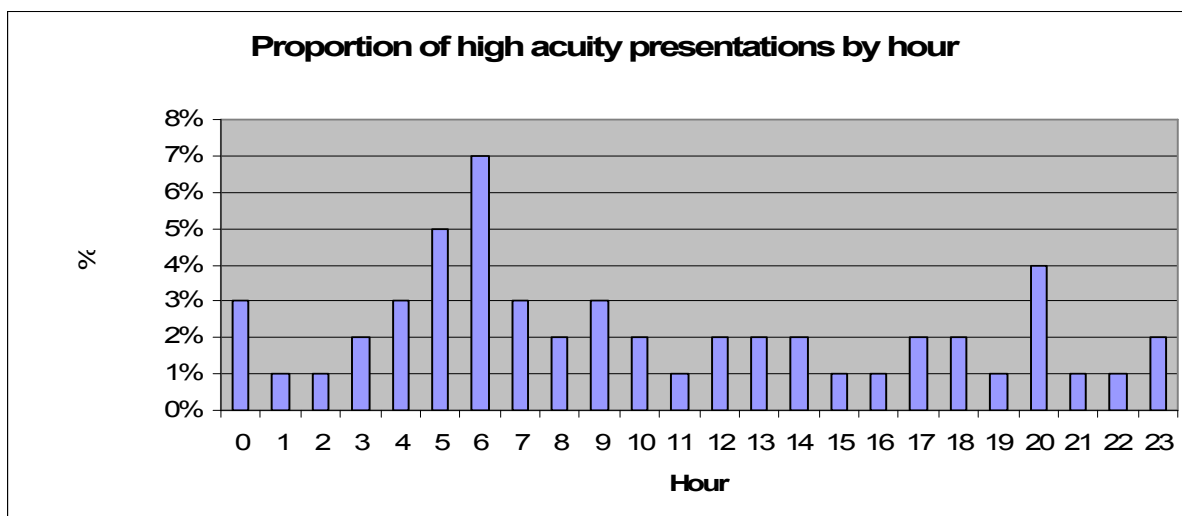
There were a relatively constant number of presentations after hours with peak presentations between 10.00 and 16.00 hours as shown in graph 5 .

Graph 6 shows the TC1/2 presentations expressed as percentage of all presentations during an hour. The total number of presentations is lowest in the early morning

Graph 5: Number of presentations to QISU participating emergency departments by time of presentation (1998-2005)



Graph 6: Triage category 1 or 2 presentations expressed as a percentage of hourly presentations (1998-2005)



hours; however those presentations are of higher acuity.

Discussion

In 2004-2005, there were an estimated 27,400 persons employed in the mining industry in Queensland, making it one of the largest employment industries in Queensland (4th largest civilian labour force after manufacturing, retail and property /business services)⁽⁵⁾. The majority of workers in the mining industry are employed by large companies. Only 3% of workers are estimated to be self-employed.

Mining involves a wide variety of work environments and employees of different age, occupation, experience and training. Workers may be directly involved in mining or part of an extensive service and support group. Mines may be above ground mines/quarries or underground mines and are often located in rural/ remote areas, requiring employees to travel long distances to and from work often at the end of a long and tiring shift.

The work environment in mines is often noisy, crowded, dusty, hot and humid. Once a highly physical occupation, mining is now dominated by the use of heavy machinery and power tools. Perhaps more than in any other industry, miners rely on procedure and protocol to maintain the safety of their physical surrounds. Activities such as assessing rock stability and ensuring adequate ventilation are daily core activities.

Mining deaths

Over the last 25 years there has been no clear trend in the mining fatality rate within the mining industry in Queensland with between 1 and 16 people dying annually⁽⁷⁾. The fatality rate is exacerbated by peaks following single mining incidents responsible for multiple fatalities. Although there have been four peaks over the last 25 years, there have been no significant peaks over the last 10 years. The fatality rate over this period has fluctuated between 4 and 14 deaths per 100,000 persons employed per year⁽⁷⁾.

QISU data

The majority of injury presentations in our data were due to minor eye and hand injuries. Few presentations were due to more serious injury, with only 126 or 2% presenting requiring immediate/ urgent medical care.

Age and sex

The age distribution in our series shows a normal distribution and is likely to reflect employment age demographics. Depending on the data source accessed it is estimated that 5-15% of all Australian mine workers in 2005 were female⁽⁵⁾. Women presenting with injuries were more likely to be employed in clerical / domestic duties. The acuity and timing of injury presentations for women was similar to men. However, the injury pattern differed, with women sustaining fewer eye injuries than men.

Injury pattern

Eye injury

One quarter of all injury presentations was due to eye injuries. These injuries can be prevented by using safety glasses / face masks / welding masks. Preventative strategies for avoiding eye injury have been discussed in a previous injury bulletin (QISU bulletin No. 90). There are some obstacles to effective eye protection in the mining environment. Workers requiring prescription glasses have difficulty using some safety equipment over their glasses. Safety wear which incorporates prescription eyewear is very expensive and able to be used by only one worker. The physical mining environment is crowded and dusty and even those not directly using tools likely to cause eye damage (welding, cutting and grinding equipment) are likely to be exposed to dust and flying debris.

Pain without acute injury

A significant proportion of injury presentations were for pain or discomfort not clearly associated with acute injury. These presentations are likely to be associated with occupational exposure to noise, dust, vibration and heavy equipment. The injury sustained from this exposure is more low grade and cumulative. Correspondingly the injury presentations are delayed and low acuity.

Some presentations in this category may be explained by or exacerbated by psychological factors. As QISU data is collected by the triage nurse on presentation, more complex factors pertinent to the presentation may not be obvious and are likely to be poorly identified in our data.

Acuity and time of presentation

The majority of injury presentations were low acuity. High acuity presentations accounted for only 2% of all presentations. Although women represented a small proportion of overall presentations, the proportion sustaining high acuity injuries and the cause of these presentations was similar to men.

Most mines have first aid equipment available at each work site to administer immediate care/ resuscitation (if required). In particular, burns and chemical eye

exposure require immediate irrigation to reduce the injury. High acuity injuries are likely to present to hospital as soon as possible. However, presentation may be delayed by entrapment, and transport times. The majority of emergency department presentations are seen during normal working hours. High acuity injuries, however, were more likely to present at 2000 hours (4% of presentations in that hour) and between 0600 and 0700 hours (5 and 7%). These times may correspond with times of fatigue or travel to and from work.

Workcover

Only a small number of work related injuries in the mining industry are covered by Workcover Queensland. The majority of large mining companies are self-insured for work related injury. Central reporting of all work related injuries in Queensland is managed by Qcomp. There are a relatively

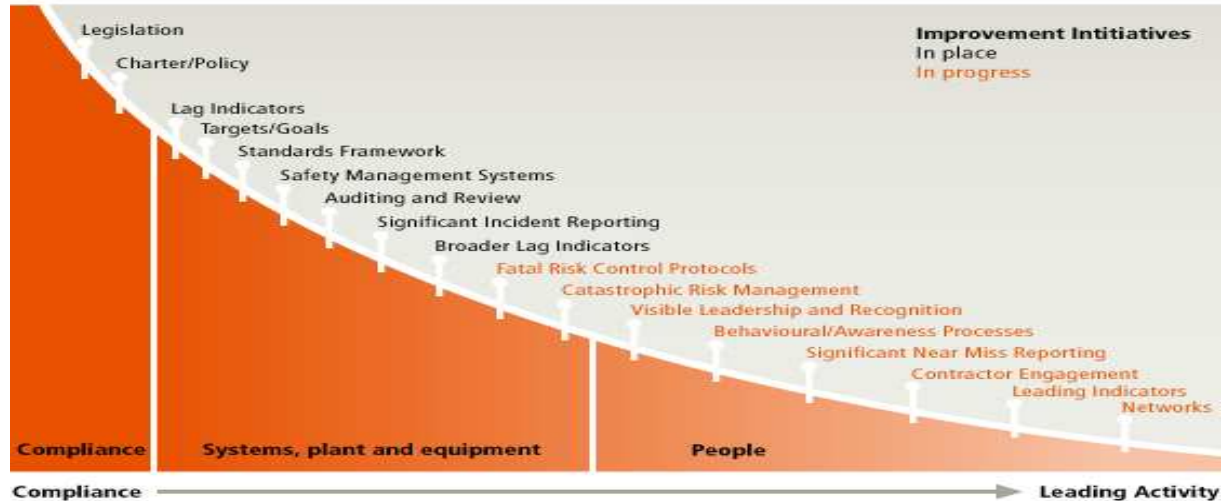
low number of claim intimations (200 p.a., Qcomp) related to mining. However, the mining industry has the highest average finalised time lost claim cost compared to all other industries. In 2005-2006, injury in the Queensland mining industry cost \$AU 20.3 Million with an average of 54 days off work per claim⁽⁶⁾.

Prevention

Many aspects of mining operations are governed by relevant safety and operational standards. People involved with the mining industry have a legal obligation to follow health and safety laws (Coal mining Health and Safety act 1999, coal mining; Mining and Quarrying Safety and health act 1999, metalliferous mining) These laws relate to training requirements of workers, safety equipment, handling of machinery, storage of chemicals and detection of potential rock fall and gas build up. These standards are implemented by the mines inspectorate. The mines inspectorate addresses all aspects of the safety improvement map (see Graph 7).

The left hand of the diagram reflects the legislative/ policy base against which compliance can be measured. The middle part illustrates all practical aspects of work, in particular safety management systems and auditing of processes and protocols. The right hand section deals with the





human aspect of implementing and maintaining safety systems.

Injury/ incident reporting

In recent years the mining industry has increased safety measures to include reporting of all incidents (death / injury and all incidents where there has been potential for injury). There is a classification system in place that dictate how each incident is to be investigated. Near misses (high potential incidents) are audited with the aim of identifying system failures and preventing future serious incidents/ deaths. This system is highly formalised with direct reporting to the Department of Mines. Information regarding deaths and high potential incidents is circulated to mining facilities across the state in order to inform urgent practice/ systems changes if required. The number of reported high potential incidents has increased dramatically since the change of incident reporting and adoption of the Incident council analysis System (ICAM) in 2002. In 2004-2005, 715 high potential incidents were reported, a increase of nearly 30% compared to the previous 3 year average (2003/4-536, 2002/3-559, and 2001/2-457). This increase may reflect an increasing rate of reporting rather than an actual increase in the number of incidents. Whilst deaths are likely to be correctly reported, problems exist with identification and underreporting of potential incidents.

Fitness for work

Fatigue and substance abuse have been identified as contributors to injury risk

generally and are particularly relevant in a male dominated, often isolated work force. Workers generally are working eight to twelve hour shifts on a 24 hour rolling roster. Some employers have made attempts to step workers through a series of day evening and night shifts in order to minimise the physiological stress associated with shift work. This is not standard across the industry. Workers need to be disciplined in catching up with sleep during time off. Many mines employ regular drug testing techniques such as breath testing pre-shift and intermittent urine drug screening to ensure that employees are not performance impaired when on shift.

The cyclical structure of the mining industry with bust to boom provides less security than other industries. Financial, personal and health considerations often provide significant stress for mine workers on several levels. Such psychological components are not traditionally seen as the responsibility of the employer. In 2002-2005, 15 of the potential serious incidents were attributed to psychological/ mental problems, illustrating that the psychological health of an employer can have some impact on the health of the whole work community (graph 8).

Personal safety

- **Training** is highly regulated in the mining industry with workers required to achieve specific competency goals before being allowed to work in certain areas or on certain tasks. Competencies may include machine training or resuscitation/ rescue

training (CPR/ respirator training). There is always a skill mix of experienced mine workers ,skilled workers who have not previously worked in a mine environment and unskilled labourers enabling the more experienced workers to pass on skills.

- **Personal protection** (such as goggles, masks and hard hats) is required according to the area and type of activity.
- **Preventative health** includes regular health checks of mine workers and stringent rules regarding the return to work following injuries. Some states (not QLD) have introduced screening for psychological stress.
- **Individual Safety Awareness** strategies are reinforced by many mine employers. Slogans such as “If in doubt, get out” and “PASS” (positive attitude safety system) are used to remind workers to react appropriately to any situation that they perceive as being unsafe.

This level of personal safety should extend to all personnel employed on a mine site (mine employees, service and contracted staff). Varying employment arrangements within the mining workforce may influence safety standards and reporting. Regular work in the risk environment can lead to complacency with safety strategies.

Conclusion

Despite recent legislative and policy change, mining remains an industry where the potential for serious injury is high. The

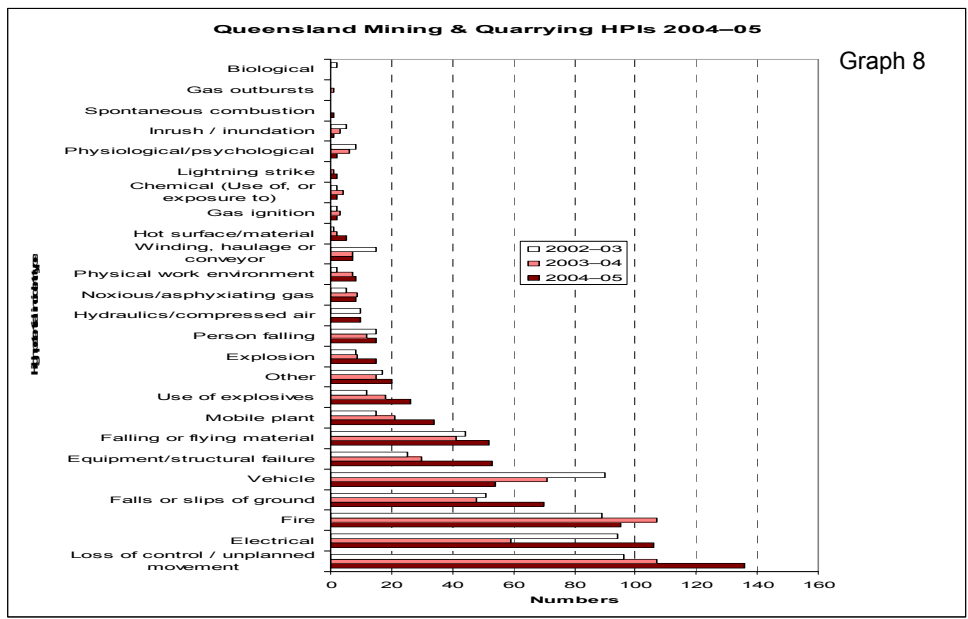
cause of mining injury is complex and multi-factorial, and no one intervention is likely to reduce the injury/ death rate. Problems remain in getting accurate reports of high potential injuries. The majority of injuries as identified by our data are low grade and yet carry high economic significance.

Recommendations

- Safety practices should be standardised for all personnel involved in the mining industry.
- Employees should be encouraged by mine employers to report all incidents and potential incidents.
- Safety training should be repeated at regular intervals.

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Graph 8