Gunther Paul, PhD AITHM 21/06/2017

Response to the Queensland Parliament call for submissions - extended terms of reference - inquiry into occupational respirable dust issues

Ref: Executive summary

Black lung – White lies: Inquiry into the re-identification of Coal Workers' Pneumoconiosis in Queensland. Report N0.2, 55th Parliament Coal Workers' Pneumoconiosis Select Committee, May 2017.

I hold a Master's degree in Control Engineering, and a Doctorate in Ergonomics/Occupational Health and Safety (Doctor of Engineering) from the Technical University of Darmstadt in Germany. I am currently the James Cook University Principal Research Fellow in Occupational Health and Safety, and affiliated with AITHM.

Our response relates to all occupational respirable dust exposed workers, including coal miners, coal port workers, coal rail workers, coal-fired power station workers, and other workers.

It furthermore refers to the legislative and other regulatory arrangements of government and industry which exist in Queensland to prevent or reduce the harm caused by occupational respirable dust exposure to mine, port, rail, power station, and other workers; and whether these arrangements are adequate, and have been adequately and effectively maintained over time.

We also comment on the roles of government departments and agencies, industry, health professionals and unions in these arrangements.

Finally, we comment on the efficacy and efficiency of adopting methodologies and processes for respirable dust measurement and mitigation, including monitoring regimes, engineering measures, personal protective equipment, statutory requirements, and industry policies and practices, including practices in jurisdictions with similar industries.

The response argues that significant change is required in managing coal workers' health, and it proposes a framework that builds directly on findings and recommendations explicitly summarized in the referenced report; as well as implicit findings drawn from the report, which have not been formulated into recommendations by the authors of the report. This framework explicitly supports recommendations expressed in the report in regards to the establishment of a one-stop shop health surveillance scheme, which goes significantly beyond the improvements and corrections of the current Mine Workers' Health Scheme proposed in the Monash University report and through tendering processes opened by the Department of Natural Resources and Mines (DNRM).

Background

In Queensland, coal miner's safety and health is guided by the Coal Mining Safety and Health Act (CMSHA)(1999) and Regulation (2001), and the Mining and Quarrying Safety and Health Act (1999) and Regulation (2001); vs. the harmonized Work Health and Safety Act (WHSA) and Regulation (2011) guiding all other work systems.

CMSHA defines the mandatory Coal Mine Workers' Health Scheme in Part 6, Division 2 of the Regulation. Relevant elements for coal mine dust lung disease (CMDLD) are a pre-employment medical assessment (screening), and a once every 5 year health assessment including medical history, physical examination, spirometry and A-P CXR. The periodic assessment includes some level of health risk assessment. Health assessments are only required for workers employed for other than low risk tasks.

The current health scheme is focused on fitness for work assessment. It does not:

- Provide a health status to run an early warning system for respiratory disease,
- Account for a modern, essentially contracted workforce,
- Advise standardized diagnostic criteria,
- Advise a clinical pathway for diagnosed abnormalities,
- Provide health information history to NMA,
- Prevent incomplete or false health assessments, or
- Provide a group health surveillance system capable of monitoring population trends, and informing WHSQ, DNRM, Queensland Health, and industry or worker representatives. It does not provide valid, reliable or consolidated data that would enable to predict prevalence and incidence rates, or inform programs to design interventions/prevention.

The scheme is not managed centrally; it largely uses paper based processes, doesn't comply with modern records management principles, and doesn't interface with other stakeholder systems, such as WHSQ, SWA, and Queensland Health etc.

Worker health in Queensland is managed by DNRM, thus acting in a **legislative** (preparing policy) role, while concurrently performing statutory authority as the regulator, managing health assessments (**mining and health executive**); in contrast, other legislations are separating the different levels of authority.

In the US, the Coal Workers' Health Surveillance program (CWHSP) is administered by NIOSH (National Institute of Occupational Safety and Health) (**health executive**); it was established by the Federal Coal Mine Health and Safety Act (**legislative**) and is enforced by MSHA in the US Department of Labour as the regulator (**mining executive**). This organizational structure provides for a clear separation of authorities.

New South Wales set up a one-stop shop for miners' health and safety in 2002. Coal Services (CS) is established as a bi-partisan corporation owned by the NSW Mineral Council and the CFMEU (**mining and health executive**). Business units within CS provide all OHS services to the mining industry under various orders; moreover, it has statutory functions outlined in the NSW Coal Industry Act 2001 (**legislative**).

In addition to the accumulation of authorities under DNRM, the Queensland Department is operating a health and safety scheme under its core industry portfolio. This OHS scheme is not

structurally coordinated with the primary health and safety stakeholders in Queensland; WHSQ, Insurers and Queensland Health.

Scope and Definitions

While historically referred to as Black Lung, Coal Worker's Disease or Coal Workers' Pneumoconiosis (CWP), recent publications use the more comprehensive term coal mine dust lung disease (CMDLD), which encompasses a variety of other fibrotic lung diseases. Given the multitude of diseases and terms found in publications, it is important to be specific about what diseases the health scheme is covering; in particular as these diseases are occupational in nature, and thus combine a medical manifestation with an occupational exposure, such as silica dust or coal dust.

Although there is no consistency in defining the CMDLD meta-disease group, there appears common acceptance that CMDLD covers the group of CWP, the group of silicosis, asbestosis and chronic obstructive pulmonary disorder (COPD). The first group of CWP can be assumed to contain anthracosis (mild CWP), which is also common amongst urban dwellers and not industry specific; simple CWP, and complicated CWP, also referred to as progressive massive fibrosis (PMF). Mixed dust pneumoconiosis (MDP) and diffuse dust-related fibrosis (DDF) can be added to this disease group; as well as a more rare combination of pneumoconiosis and rheumatoid arthritis, called Caplan's Syndrome. Diseases in this spectrum have similar aetiology, with symptoms related to fibrosis and lesions; however they differ in pathogenesis. The second group of silicosis, consist of chronic simple (>=10 years exposure), accelerated (5-10 years exposure) and complicated silicosis (also referred to as PMF). Acute silicosis occurs from a few weeks to 5 years of exposure, is related to high concentrations of silica dust, and often leads to death. This group has a similar aetiology related to lung tissue scarring and related inflammation processes. Asbestos is no more mined in Australia, and hence this disease can be excluded. The COPD group includes chronic bronchitis and emphysema, which are older terms used for the same disease (emphysema) or a specific manifestation of the disease (chronic bronchitis). CMDLD cannot be cured, and management of the disease requires removing the worker from the dust source, limiting further exposure. Eventually, severe forms of CMDLD may require lung transplantation.
This scope is summarized in Figure 1.

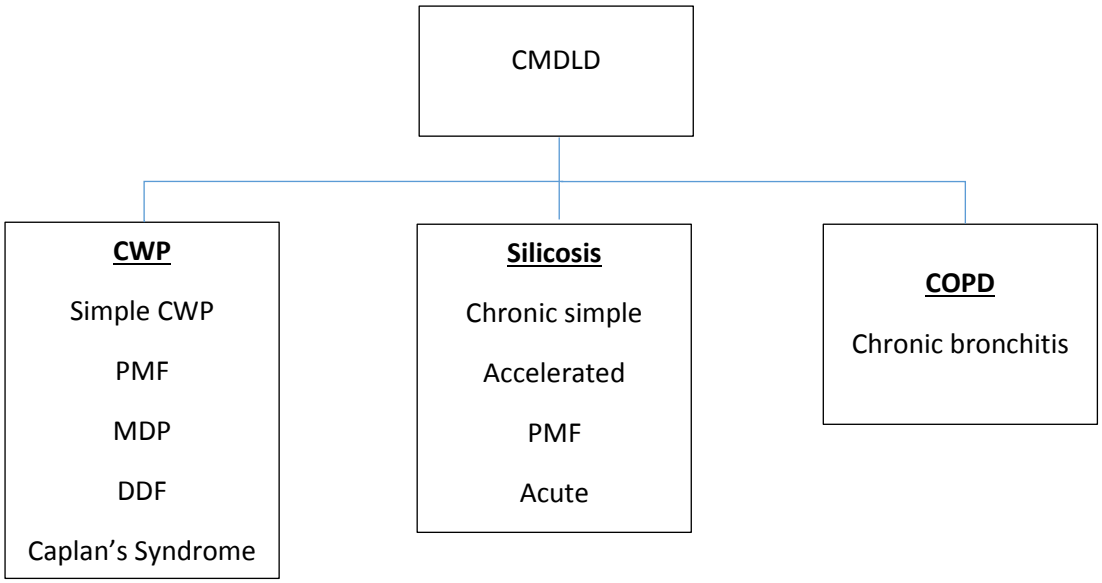

Figure 1: Spectrum of CMDLD diseases within the scope of Queensland's Miner Respiratory Health Scheme.

Exposure and Risk

Development of CMDLD is related to the respirable dust exposure dose, calculated from exposure intensity and duration. This apparently is also related to work organization (time), tasks, mining practice, mining technology, mine mineral composition, and prevention methods (e.g. water spraying, PPE, ventilation, etc.). An exact task analysis, as often key to ergonomic analysis, is paramount; for the equipment used and exact tasks performed will determine the primary exposure (e.g. diesel exhaust machinery, use of enclosed cabins, drilling equipment type, drill speed, coal seam height, airflow etc.). It is understood that, although available and recommended by NIOSH, personal wearable exposure measurement is not common in Queensland. The permitted mean respirable dust concentration (PEL) over an eight hour shift (TWA) in Queensland is significantly higher than recommended (REL) by NIOSH ($3mg/m^3$ vs. $1mg/m^3$), but periodically this level is peaked above $6mg/m^3$, without a good understanding of the impact of a maximum workplace exposure and workplace exposure limits (WEL), which are not regulated in Queensland. Given the difference between NIOSH and Queensland PEL regulations, the pathological foundation for the 95% threshold limit value (TLV) for CMDLD remains to be established, as it must be consistent. In addition to underground miners, open-cut (surface) miners and workers in the logistics and processing chain are also known to be exposed to significant levels of coal dust; although Australian research and the Regulation have not covered this aspect in the past. It is recommended the committee consider the Australian Institute of Occupational Hygiene (AIOH) position paper on “Dusts not otherwise specified and occupational health issues” from the AIOH standards committee (2014). This position paper considers international best practice, and goes significantly beyond current legislation and the recommendations made in the MONASH report in its recommendations.

Exposure measurements in Queensland are not mandated, although they must be considered a critical part of risk assessment, which is an obligation of the employer under s.49 of the regulation. Given that the miner health assessment, which is another obligation of the employer, is based on proper risk assessment as per s.46 of the regulation, correct exposure measurement is the most critical element in the health scheme. The only exiting statutory requirement vaguely relating to exposure measurement however is founded in s.49, which states that “A coal mine’s safety and health management system must provide for periodic monitoring of the level of risk from hazards at the mine that are likely to create an unacceptable level of risk”. This does not include an explicit requirement for measuring dust exposure, and it doesn’t specify an interval for such measurements. Moreover, s.89 of the regulation specifies the maximum acceptable average respirable dust concentration for coal dust and free silica over an 8 hour period, under the responsibility of the mine’s safety and health management system. DNRM does not monitor coal mine dust exposure per se, however mines can be somehow expected to conduct ongoing, continuous monitoring to comply with s.89(1b) of the regulation. This monitoring service is also offered by SIMTARS, which is a DNRM unit. Mines are required to record this data, and make it available to mine workers at the mine. Reporting requirements to the inspectorate are only triggered after a second trigger event, and only if a site senior executive becomes aware of excessive dust levels. Under due diligence, it should be expected that a fair amount of data has been made available to DNRM over the years. While s.89 of the regulation explicitly refers to respirable dust in coal dust and free silica in setting the OEL, measured according AS 2985, schedule 9 of the regulation neither specifies what constitutes coal dust, nor what constitutes free silica; leaving the OEL to wide interpretation. Given that only laboratory analysis is able to determine the composition of sampled dust, a timely response to excessive dust levels, as expected from the regulation, is practically impossible.

Finally, the obligation to manage risk of injury or illness lies with the workers themselves under s.36(2a) of the Mining and Quarrying Safety and Health Act (1999), not the operator; for the operator and operator appointed site senior executive take only responsibility for general risk limitation, and development, implementation and maintenance of a safety and health management system (ss.38-39). It is questionable how a worker should comply with this responsibility.

Overall, there is currently no systematic monitoring of the most critical element of the risk management system in Queensland, which is exposure to coal and mineral dusts. As a consequence, we find insufficient evidence for designing meaningful interventions and providing health services at all levels of the scheme.

Exposure in the US was found to exceed the US PEL of 2mg/m^3 in 6.5% of control measurements, and it exceeded the REL in 24.6% of measurements in 1995-2003. Control data for Queensland is not available.

In addition to dust exposure while working, it is likely a miner's habitat will be exposed to increased levels of coal and mineral dust. This increased respirable dust particle dose exposure will have to be considered in determining a healthy OEL. Currently this is not the case.

Similarly, workers in the coal transport chain or in coal powered plants will be exposed to environmental and occupational coal dust, and as for miners, the combined dose of particle exposure needs to established and considered in setting a standard. No epidemiological data is currently available in this regards.

Measurement

Advanced devices used in measuring dust exposure in mines, such as the ThermoFisher Scientific PDM3700 Personal Dust Monitor or Casella Dust Detective measure PM10, PM2.5 and inhalable and respirable fractions of dust. They do not analyse measured particles, and will not provide information about the chemical composition of particle matter. Given that occupational hygiene exposure limits refer to specific matter properties, such as "low toxicity", the scheme must be expected to regulate analysis of collected particle matter. This is currently not the case in Queensland.

Epidemiology

Limitation of dust exposure in the US reduced CWP prevalence in underground miners from 11.2% in 1970-74 to 2.0% in 1995-99, and reduced mortality from over 15 to 2 (2001-2010). However since 2000, CWP prevalence has started rising again to 3.2% in 2011, which has been attributed to new mining equipment and technologies, potentially producing smaller dust particles and higher dust concentrations. Without consideration of surface miners who were not surveyed, data from 2010-11 indicates a CWP prevalence of 2.0% for CWP (compared to 2.7% in 2005-09), and 0.5% for PMF respectively. Combined data for 2005-15 indicates CWP prevalence of 2.4%. Mortality in Australia is thought to be around 5, and prevalence in 2002 was estimated at 1.3-2.9%. Australia however has no reliable data on CWP prevalence or mortality, as the disease was found to be incorrectly diagnosed in Queensland (false negatives). Chinese data identifies CWP as the dominant occupational lung disease, with a prevalence of 6.0% in 2001-11. In raw numbers, this roughly equates to 6,000 deaths p.a. caused by CWP in China vs. 1,000 deaths p.a. in the US. Prevalence in Colombia was found to be 36% as reported in 2015, and prevalence in South Africa was reported as 4.2% in 2003.

When analysing age and severity of the disease, younger miners with relatively short exposure times were more likely to develop PMF, the most severe form of CWP.

Given the long latency of over 10 years for CWP, much of the epidemiological data is disputable, as Australia for example does not survey and record CWP post-employment; additionally, the 5 year survey interval in Queensland may not adequately identify cases in a modern, highly volatile contract employment environment.

Recent studies have questioned the relationship between coal dust exposure duration and CWP incidence rate, although a positive linear relationship between coal dust concentration exposure and incident rate could be confirmed.

In addition to particle concentration, which is purely based on measurement of particle weight, the German National Institute of Occupational Health considers that particle size has a significant impact on aetiology and pathogenesis of CWP.

Health assessment

The quality of health assessments by NMA was questioned in the Monash report, which is referenced in the committee inquiry. Although the quality of assessments as such is not an explicit element of this proposal, the way assessments were carried out does play a role in higher level system failure. In particular,

- Personal health records were not considered, as they were not available;
- CXRs were sometimes not administered due to incorrect risk classification;
- When CXRs were administered, they were not coded according to ILO classification;
- CXR image processing, reading and assessment was poor;
- CXR image transfer and record keeping was not fully digitized;
- CXR images history was not available;
- Quality control of spirometry was poor;
- Spirometry was not conducted to established standards;
- Spirometry results were predominantly incorrect, which was not identified through the system;
- Risk from dust exposure, a key element of the health assessment method, is not clearly defined by regulations, leading to different interpretations;
- Risk from dust exposure was not correctly considered, because employers incorrectly specified and recorded SEGs;
- SEGs could not be established, because only a minority of companies monitor dust exposure;
- The use and impact of dust control technologies and measures is not considered in the SEGs;
- The exposure of contractors to various job categories/tasks, different mines and different locations in mines has not been considered;
- NMAs are predominantly GPs, and unaware of job profiles and working conditions as expected from Occupational Physicians;
- There is no clear differentiation between the responsibilities of the NMA and EMOs, who often perform the health assessment in an undefined role; and there is no defined handshake between their contributions;
- The scheme relies on ordinary mail transfer of documents and manual coding at DNRM, with a significant backlog;

- Records at DNRM are not maintained at an expected level, and many health records are inaccessible;
- Health assessment on retired workers is excluded from the scheme, although the information is substantial for effective health surveillance and the identification of risk from exposure to dust;
- A lack of training and skill was recorded at all levels of the health assessment, including NMA, EMO, radiographer and spirometry;
- DNRM health assessment information is not synchronized with, nor cross-referenced against Queensland Health, Q-COMP, WHSQ, SWA, WorkCover, or Private Insurer data.

Overall, it is the systemic failure – i.e. the problem with the system in its whole, as compared to poor performance of single elements – that is of concern. This systemic failure warrants a systems approach, including systems engineering and work system analysis. Such an approach uses vastly different methods than traditional process optimization. So far, DNRM has applied a traditional process driven approach by commissioning new standards for NMA education, lung function tests and chest X-Rays, and the systemic failure has not yet been acknowledged.

Clinical Pathway

The current respiratory component of the miner health scheme has been identified to serve predominantly as a fit-for-work assessment, rather than a clinical pathway for diagnosis and treatment of work related respiratory diseases. CMDLD are occupational diseases that require an occupational health pathway for management; which is distinctively different from a typical, general health medical pathway. Because CMDLD are predominantly not acute symptom diseases, they require a population-based epidemiological health pathway. This pathway necessitates providing access to epidemiological and exposure data for the treating medical practitioner, the NMA. The OH medical pathway is highly unlikely to be triggered and pursued by the patient; instead it needs to be process driven and controlled by an OH medical authority. NMA currently do not perform this function, nor does any other medical entity in Queensland. The responsibility however lies with DNRM.

Under the current scheme, Mining companies may measure, assess and classify coal dust exposure, and provide this information to the NMA in a paper-based process. The information is regularly not available, thus critically limiting the NMA's ability to perform an OH diagnosis. EMO as an additional system element often conduct the assessment, so that NMA would have to provide this information to EMO, again in continuation of the paper based process. The value of an EMO medical remains questionable, if they cannot be provided key occupational background and exposure information. Furthermore, it is unclear how EMO reports back to NMA can be supervised and controlled for quality, if critical information is missing and no specific quality control process is in place. The same applies to radiology and spirometry services, which may be EMO, or not. Evidence has shown that clear CWP diagnoses were not followed up by NMA. Realistically, the current medical pathway starts and ends with the NMA. There is no process for a hand-shake between Mining Company, NMA and hospital based specialist services, and typically it will be up to the patient to coordinate treatment once a positive diagnostic finding has been made, as NMA see their role as fitness-for-work assessors and not as critical element of a clinical pathway. It has been reported that miners are particularly un-cooperative for this reason, for once they have been diagnosed with CWP, and will become "unemployable", and likely unemployed, their OH medical pathway ends and they will enter a complicated general health medical pathway, which is not aligned and compatible with the occupational health problem.

Health surveillance

The monitoring of workers' exposure (s.136) and health surveillance (s.138) are currently regulated under the Qld Mining and Quarrying Safety and Health Regulation (2001). The regulation puts an onus on a site senior executive to identify excessive exposure to a hazard, and assess if the condition may have adverse health effects; as well as if valid biomedical techniques exist for detection. The senior site executive must then arrange for health surveillance by an appropriate doctor (s.138). Given the non-cognate background of typical senior site executives, and the engagement of NMA who are general practitioners, it is unclear how this process could work. Health surveillance in occupational settings is internationally recognized as a task for certified and trained specialist Occupational Physicians (OP); however this is not mandated, and OP are not included in the health scheme.

Assessment of the current miner health scheme

The respiratory component of the miner health scheme is not designed as an occupational health scheme, for the multiple reasons stated above. It fails to address essential requirements for such a scheme, such as data gathering for groups of people, description of health and disease profiles, prediction of health status, design of interventions and control of the change in the health and disease profile. The long-lasting assumption of an eradicated disease CWP in Queensland gives hence evidence of the failed scheme.

The core element of every occupational health scheme is valid and reliable data. The lack of such epidemiological and exposure data in Queensland, and the effective lack of active and passive health surveillance processes in an occupational set-up, must be considered the critical failure of the scheme. Besides, the scheme currently employs distributed services, without a management framework to facilitate its operation and support control functions.

As a consequence, an excessive number of often insufficiently qualified NMA or EMO, insufficiently qualified radiologists and spirometrists, and low quality service delivery remained unidentified for many years; as did the existence of CWP in Queensland miners.

Proposition

The consortium proposes a long-term strategic approach to research into a tropical occupational health surveillance scheme for miner's health; and delivery of its related components in a translational and holistic evidence-driven set-up.

In the near future, the Tropical Australian Academic Health Centre TAAHC will be the Northern Australia Centre for Research Development and Translational Science. Until the TAAHC will be fully established and operational, this proposal builds on JCU and AITHM capability.

AITHM is the Australian Institute of Tropical Health and Medicine, providing high level research and governance to the proposal in a triad of research, clinical services and education.

The Mackay Institute of Research and Innovation MIRI implements the Centre of Excellence or "One-Stop-Shop (OSS)" for Miner Health and provides all OSS related occupational health services.

The Australian eHealth Research Centre (AEHRC) is a joint venture between CSIRO and Queensland Health, providing expertise in radiology assessment, image analysis, data interoperability and the Health Internet of Things, including wearable sensor technology.

Ernest & Young (E&Y) is a very large international consultancy with high level expertise in program delivery lifecycle, from idea generation through to technology development, implementation and program governance.

Proposal 1:

Set up an independent One-Stop Shop (OSS) provider in Mackay for developing and operating a cohesive Miner Work Health and Safety Scheme in Queensland, similar to CS Health and CS Technical Services ion NSW, an in-line with the NIOSH gold standard for a Miner Health scheme in the US. Establish an Australian Registrar, who in collaboration with the Australasian Faculty of Occupational and Environmental Medicine and Rural Generalist Training will manage training and certification governance for mining medical advisors through the OSS (JCU/AITHM, E&Y, MIRI).

The OSS structure will include elements of an OHS outpatient clinic, OH services, OH research and OH rehabilitation, consistent with the Finnish Model for OHS Service Organization, in a holistic approach towards OHS management (Figure 2).

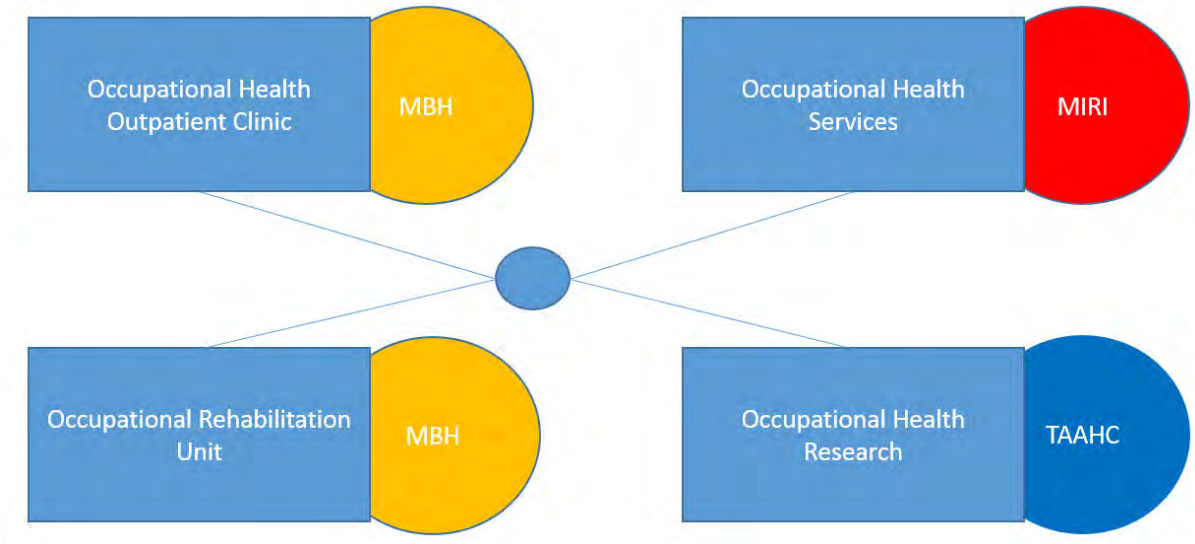

Figure 2: Proposed Mining OHS One-Stop-Shop structure.

MBH refers to the Mackay Base Hospital (also: Mackay Hospital and Health Services, MHHS), which has capacity to deliver an outpatient clinic (Figure 3) and rehabilitation unit (Figure 4) for OHS purposes. All occupational health services (Figure 5) are delivered within MIRI, which is structurally interfaced to MHHS. Occupational Health research (Figure 6) is delivered in collaboration between JCU/AITHM and AEHRC, feeding evidence-based methods into all three conjoint units and also enabling the key structural information exchange linkages for real-time access to all relevant data. This unit will additionally manage a central database, which serves as the heart of the system.

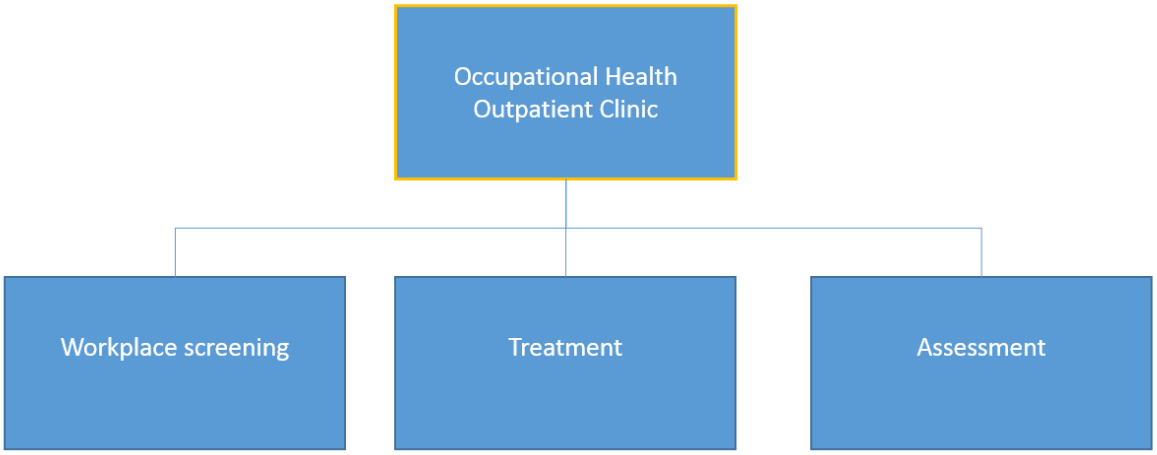

Figure 3: OH outpatient unit structure.

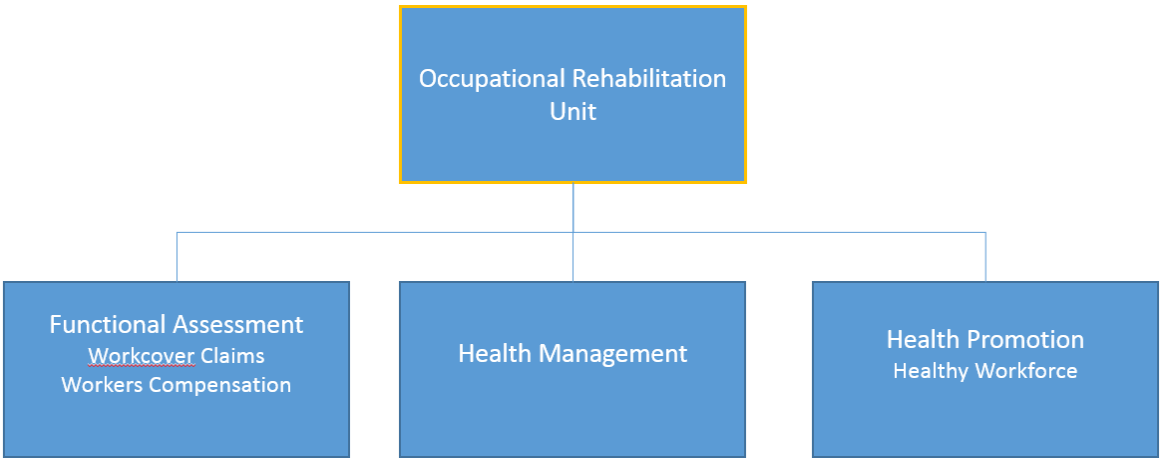

Figure 4: Occupational rehabilitation unit structure.

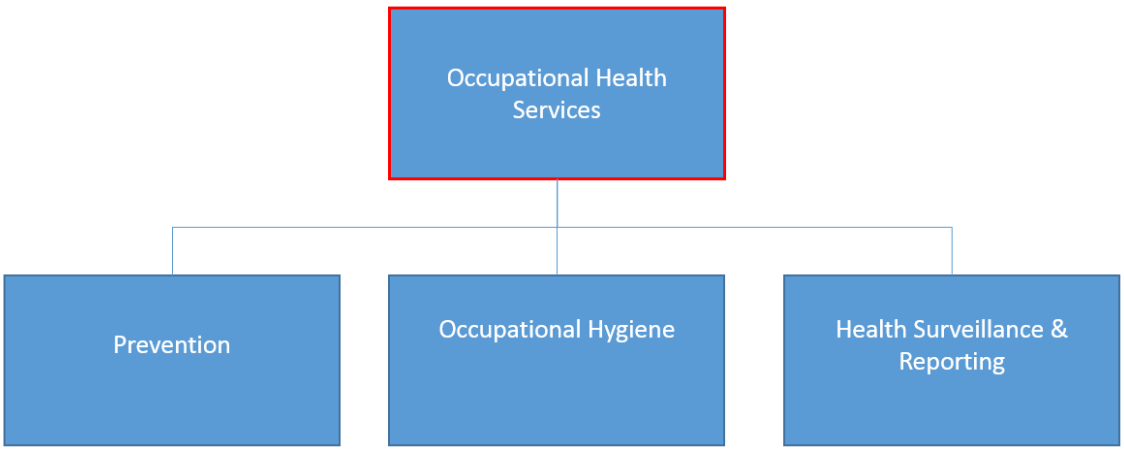

Figure 5: Occupational Health services unit structure.

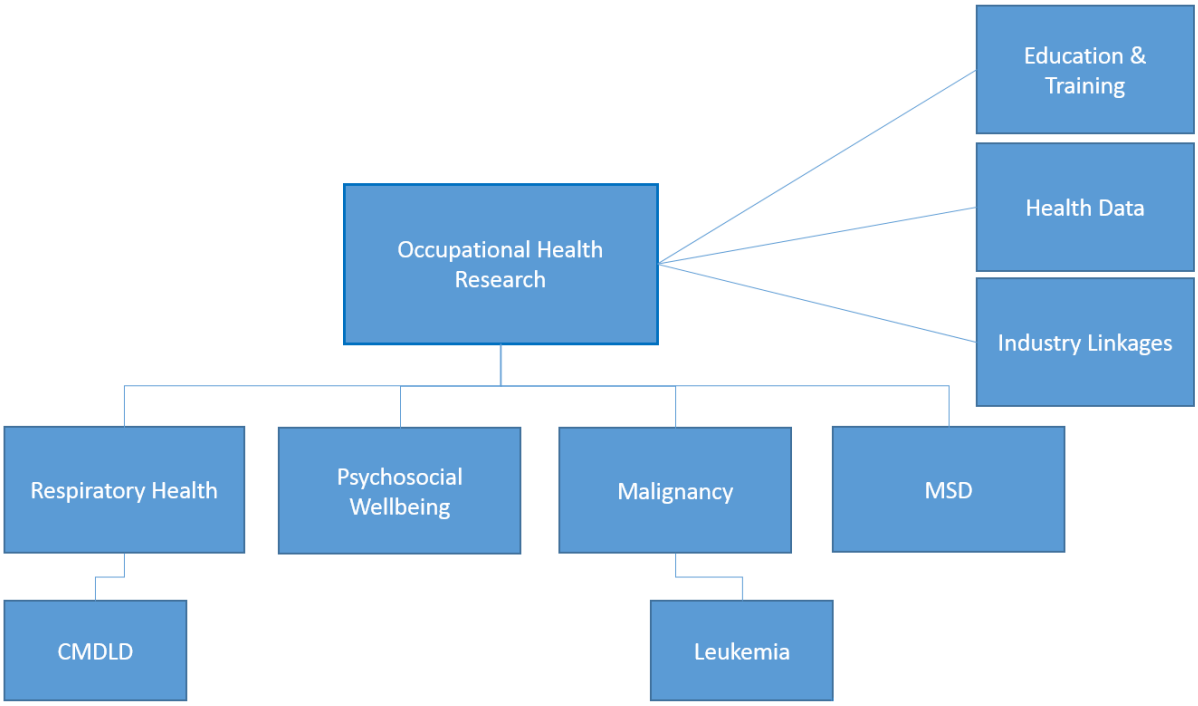

Figure 6: Occupational Health research unit structure.

Proposal 2:

Establish a population health surveillance unit, including revised measurement and reporting standards, and a central database for all Miner Work Health and Safety data in Queensland, enabling real-time interfaces to all existing relevant systems, through AEHRC, E&Y and JCU/AITHM, making use of Australian National Data Service (ANDS) capability.

Proposal 3:

Define a unified protocol for all Miner Work health and safety data to enable seamless data transfer between all health system participants (central database with connected external agencies, NMA, EMO, radiologists, spirometry, mines), through AEHRC and JCU/AITHM. Consider full-life-cycle digitization, digital imaging and spirometry, and artificial intelligence methods for timely, automated record assessment where possible.

Proposal 4:

Implement a communication infrastructure that connects all system partners, including remote sites and remote NMA (JCU/AITHM, E&Y, MBH and associated partners).

Proposal 5:

Implement international best practice or common practice protocols and quality control for all relevant exposure and health status measurements, and derived secondary data; to support epidemiological evidence and cross-sectional analysis (AEHRC, E&Y, JCU/AITHM).

Proposal 6:

Conduct research at AITHM in Central Queensland to establish well-defined SEG and risk definitions (JCU/AITHM, MIRI), as well as an improved understanding of CMDLD aetiology, pathogenesis,

management and prevention. Conduct research into advanced exposure measurement, analysis, and innovative engineering controls and interventions.

Proposal 7:

Mandate (wearable) dust exposure measurements for all at risk workplaces and tasks. Conduct valid workplace assessments to identify reliable risk levels. Develop innovative (wearable), real-time, networked dust sensor technology through AEHRC, JCU/AITHM and research partners where required.

Proposal 8:

Extend the Miner Work Health and Safety scheme to retired workers, consistent with established aetiology and pathogenesis of CMDLD; as well as all workers along the mine processing chain, who are exposed to levels of dust that cause a high risk to worker health (JCU/AITHM, MIRI, MBH).

Proposal 9:

Expand the Miner Work Health and Safety scheme to include CMDLD related rehabilitation services and governance, in coordination with RTW coordinators in industry, WorkCover and Queensland Health (JCU/AITHM, E&Y, MIRI, MBH).

Proposal 10:

Provide a mobile OHS OSS service to remote mines, including OH outpatient clinic, OH services and OH rehabilitation representation (MIRI, MBH).

Proposal 11:

Include environmental exposure measurements for the revised Mine Health and Safety Scheme, in a holistic Health Safety Environment perspective (HSE); considering interaction and superposition effects of combined occupational and environmental exposures for an effective overall dose of dust exposure.

Consider potentially elevated environmental exposure in mining communities, and revise EHP regulations to consider the elevated risk from dust exposure in mining communities by increasing the density of environmental surveillance in relevant locations.