Study Protocol

Cancer and Mortality among Queensland Coal Mine Workers

Administering Institution

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Glossary

ACD	Australian Cancer Database
AIHW	Australian Institute of Health and Welfare
AARNet	Australia's Academic and Research Network
CI	Confidence Interval
CFMEU	Construction Forestry Mining and Energy Union
CWP	Coal Worker’s Pneumoconiosis
CVD	Cardiovascular Disease
CXR	Chest x-ray
DALY	Disability-Adjusted Life Year
DEE	Diesel Engine Exhaust
DNRME	Department of Natural Resources, Mines and Energy
HREC	Human Research Ethics Committee
IARC	International Agency for Research on Cancer
JEM	Job Exposure Matrix
MonCOEH	Monash Centre for Occupational and Environmental Health
NDI	National Death Index
NIOSH	National Institute for Occupational Safety and Health
PMF	Progressive Massive Fibrosis
RR	Rate Ratio
RSHQ	Resources Safety and Health Queensland
SIR	Standardised cancer Incidence Ratio
SMR	Standardised Mortality Ratio
USA	United States of America
YLD	Years Lived with Disability
YLL	Years of Life Lost

1. Background

Coal mine workers are exposed to diesel engine exhaust (DEE) from mine machinery, and silica, e.g. from cutting rock beyond the coal seam and from roof-bolting. According to the International Agency for Research on Cancer (IARC) (1, 2) both agents are Group 1 Human Carcinogens acting on the lung. Ultrafine particulates have also been implicated in increased heart disease mortality, (3) including diesel engine particulate (4). The interactions between coal dust, quartz and silicates are thought to lead to a range of pathological changes in the lungs. (5, 6) These "dust" diseases include the classic fibrotic lung disease coal workers' pneumoconiosis (CWP) or "Black Lung", which is an untreatable but preventable, more severe progressive massive fibrosis (PMF), silicosis, and mixed dust pneumoconiosis (7, 8).

Several cases of CWP have recently been remerged in Queensland, although few cases of CWP have been diagnosed in other states. The only recent retrospective pneumoconiosis mortality surveillance in Australian was conducted in 2006 (9). This study found that nationally, more than 1000 deaths had been attributed to pneumoconiosis between 1979 and 2002, with 6% classified as CWP. The number of fatalities decreased steadily over time despite the rapid increase of other types of pneumoconiosis, such as pneumoconiosis due to asbestos dust and pneumoconiosis due to silica dust (9). The 2019 report from The Department of Natural Resources, Mines and Energy (DNRME) identifies that 39 CWP cases (including those in the case series above) have been diagnosed since 1984 (10). The National Death Index (NDI) data review found deaths due to pneumoconiosis (J64) in men increased from 99 in 2009 to 140 in 2016. There were 127 deaths due to pneumoconiosis (J64) in 2013, which gradually increased until 2016 (11). The Australian Burden of Disease Study 2015 estimated that years lived with disability (YLD) for pneumoconiosis increased by 18.9% from 2003 to 2015. However, disability-adjusted life years (DALY) and years of life lost (YLL) decreased by 12.4% and 14% respectively over this period (12). A review of the respiratory component of the health assessment for Queensland coal miners was conducted by our team in 2016. This identified several major limitations in that program and made 18 recommendations to improve the scheme (13). It is vital that we gain a better understanding of why these diseases have returned and it is important to investigate whether other conditions, such as lung cancer, heart disease or suicide are also in excess in coal mine workers.

This recent increase in CWP incidence parallels that observed in the USA. The National Institute for Occupational Safety and Health (NIOSH) had reported a decline in prevalence of CWP from 6.5% in the 1970s to a low of 2.1% in the 1990s. However, CWP prevalence in the USA subsequently increased to 3.2% in the first decade of the this century and was recently reported to be more than 10% nationally for miners with 25 or more years of work and over 20% in some areas (14). The rate of PMF in certain coal mining states in the USA has also recently increased to levels observed prior to the introduction of modern dust controls (15). A longitudinal analysis by NIOSH reported a significant decline in CWP deaths in US miners from 1999-2016 (16).

Higher rates of CWP have been observed in other countries. For example, coal miners in Chinese state-owned coal mines who commenced work in the 1970s had cumulative rates of CWP of between 4 to 17% (17). In Colombia, the prevalence of CWP was recently reported as 36% (17).

The lower prevalence of CWP in Australia, compared to the USA, was thought to be a result of less exposure to quartz, perhaps more open-cut mines, thicker coal seams, larger numbers of employees (implying bigger operations with more investment in dust control measures), and more effective use of respiratory protection (18).

The introduction of new technology may be contributing to the increase in respiratory disease. Longwall mining can give rise to four times as much dust as traditional mining (19), particularly when production rates (machine speeds) are high (19, 20). In addition, bi-directional cutting can result in increased exposure to respirable coal mine dust (19).

This cohort study is proposed to identify whether the current and former coal mine workers have increased the incidence of cancers such as lung cancer and increased mortality from diseases such as non-malignant respiratory disease.

2. Aims and hypotheses

The primary aim of this project is to identify the risk of cancer incidence and mortality coal mine workers in Queensland to reduce the future burden of cancer and mortality in this large cohort.

The specific aims are to identify whether:

- the risk of cancer incidence and/or mortality by major disease subgroups is elevated in men and/or women who have been employed as coal mine workers in Queensland,
- the risks of cancer and mortality among Queensland coal mine workers have changed over time, perhaps associated with the introduction of technology such as bi-directional coal cutting,
- specific types of mines e.g. open cut or underground and/or jobs e.g. drilling and blasting, are more closely associated with any increased risk of cancer and/or mortality,
- any identified excess risks are associated with specific coal mine exposures, such as coal dust, silica and/or diesel engine exhaust,
- risk estimates based on measured air monitoring and other hygiene data will inform occupational exposure limits and exposure carcinogenicity evaluations,
- and to estimate the likely future burden of cancer and mortality in the cohort.

The hypotheses are whether any identified risks of increased cancer and/or mortality, in particular chronic lung disease deaths, cardiovascular disease (CVD) deaths, suicides or lung cancer could be associated with:

- work in mines or jobs with higher occupational exposure to coal dust, silica and/or diesel engine exhaust,
- work in underground mines compared to open cut mines, or coal preparation plants
- work with certain technology e.g. bi-directional cutting.

3. Study design

This is a large-scale, high-quality retrospective cancer and mortality cohort study of coal mine workers.

4. Study population

4.1 Cohort assembly and study participants

In 1982, the Queensland Coal Board ordered all current Queensland coal mine workers to participate in a one-off chest x-ray (CXR) survey; retired miners could volunteer to participate. The study identified respiratory abnormalities including 75 cases of pneumoconiosis among 7,784 current and 123 retired employees (21). The Board also ordered that all new entrants to the coal industry must undertake CXR and lung function testing. Then, in 1993, a health scheme was established requiring both pre-employment medical assessment and repeat assessments at least once every five years during employment, with data sent to DNRME (enshrined under the Coal Mining Safety and Health Regulation 2017). A CXR was required if the worker was deemed to be "at risk from dust exposure" (13).

Data from the coal mine workers' medicals have been uploaded into a database held by DNRME. In 2020 DNRME was reorganized and the data are held in the newly formed Resources Safety and Health Queensland (RSHQ)). These data will be used to form a complete cohort of Queensland coal mine workers who have ever been employed since 1982.

Our pilot review of this database revealed that personal identifiers, (full names, gender and date of birth) were available for 161,448 male and 18,852 female coal mine workers and the quality and completeness of these variables was high. Job histories were collected at each health assessment and our review of these data has revealed that the job was missing or ill-defined for only 1.5% of the workers (13). Of the 180,300 individuals in the RSHQ health assessment data base, 71,700 people (66,266 men and 5,434 women) have had more than one assessment and have therefore worked for at least five years in the industry. An individual's assessments are linked by the use of a personal registration number.

4.2 Cohort comparison

The miner's cohort data from the RSHQ will be linked to national records of cancer and mortality held by Australian Institute of Health and Welfare (AIHW). The cohort's cancer and mortality will then be compared to the general Australian population to identify any excess types of cancer or types of mortality, for example from respiratory disease.

4.3 Data linkage

The primary data source used to ascertain deaths in the cohort will be the AIHW National Death Index (NDI) which holds death data from all states and territories since 1980. The NDI records are updated with fact and date of death monthly, and cause of death data are updated annually. The primary data source used to ascertain cancer cases in the cohort will be the Australian Cancer Database (ACD), also held by AIHW. All cancers, except non-melanotic skin cancers, are legally notifiable in Australia. The AIHW holds complete data on cancer cases occurring since 1982. A file containing all cohort members will be sent to the AIHW for linkage and will include the following fields:

Surname, given names, sex, date of birth and any known date of death, a unique identifier for each cohort member, the last contact date when the person was known to be alive, and last known State and postcode of residence.

The AIHW uses a probabilistic matching program to identify likely and possible matches within its existing death and cancer records. The death records which are considered to match members of the cohort will be supplied to the researchers for a final clerical review. The clerical review decides which records are accepted as true matches. We have carried out this check for several other cohort studies. The clerical review of cancer cases is done by the AIHW. The observed numbers of cancer and deaths will then be compared with expected numbers estimated from general population data, age-matched and stratified by gender.

4.4 Inclusion criteria

The cohort will include- all coal mine workers with at least one health assessment available from:

- All coal mining sectors in Queensland, including
  - underground mines,
  - open-cut mines,
  - coal handling and preparation plants
- current coal mine workers,
- retired coal mine workers and
- former coal mine workers.

Former coal mine workers are those who are still working, but in jobs outside the coal mining industry. It is especially important to include retired and former miners, as some may have left the industry as a result of illness. They are likely to have had longer exposure to coal mine dust, be older, and consequently more likely to have developed disease.

4.5 Exclusion criteria

No exclusion criteria. In sensitivity analyses, we may exclude coal mine workers with only one medical assessment as they will have worked in the mines for less than five years and could have been employed for less than one year.

4.6 Occupational exposure data

There were 54 coal mines in Queensland in 2013-2014, including 41 open-cut and 13 underground mines (22). In addition, there were 31 coal handling and preparation plants. We will compare risks by mine site type (underground, open-cut, coal preparation plants).

Job titles have been collected so individuals can be grouped by job type and risks will be examined for specific jobs e.g. drillers and blasters to identify which group(s) may be most at risk of cancer or respiratory/cardiac mortality. The coal mine workers' jobs will be reviewed in consultation with a tripartite Advisory Group (see Section 6) and exposure assessment experts, so that the job titles can be allocated to groups with similar exposure.

Individuals will also be grouped by technology in use. Most Queensland underground coal mines are now operating longwall mining. Dust control measures including respiratory protection have varied over time. The technology used at each mine and the dates of change will be collected in consultation with the Advisory Group.

Individuals can also be grouped by exposure intensity (level of exposure to coal dust, silica or DEE). In general, Queensland underground coal mines are thought to contain less than 5% silica but high silica exposure can occur during mining through rock layers and when drilling or bolting into a stone roof. Open cut mines remove soil and rock before reaching the coal seams, and there is a potential for silica exposure during this process.

A job-exposure matrix (JEM) will be constructed for coal dust, silica and DEE exposure based on measured exposure data reported to the reported to the Queensland Mines Inspectorate. In the JEM, specific jobs at the various site types, are attributed a level of exposure. The JEM will incorporate changes over time and may need to be site-specific. The Advisory Group and Mines Inspectorate can advise on the generalisability of the measured data.

The coal mine workers' jobs will be reviewed in consultation with the Advisory Group, so that the job titles can be standardised to those in the JEM. The individuals will be allocated a level of exposure for each job and the exposure-years accumulated over their career. Exposure metrics such as mg/m^3-years will be calculated on an individual basis for groups of interest e.g. underground coal face workers. This will be based on methods we have developed for use in our cohort studies of petroleum (23) and aluminium industry workers (24, 25). Exposure-response analyses can then be performed such as were carried out for benzene in the petroleum industry (26, 27).

4.7 Bias and confounding control

RSHQ has complete capture of all coal mine workers employed in Queensland since 1982, so there will be no volunteer or participation bias.

In this study, (unlike many other cohorts) serial smoking, alcohol use and body mass index (BMI) data are available for individual members of the cohort from each health assessment so recall bias with respect to these factors, is minimised. These important risk factors will be adjusted for in internal analyses. The smoking data will reduce the likely biggest source of confounding.

The death and cancer registrations held by the AIHW are a reliable source of information on occurrence and cause of death and cancer incidence for the whole of Australia (28). Only deaths and cancer diagnosed and treated overseas will not be matched. The availability of middle names and dates of last known employment from RSHQ records improve the probability of a correct match of the Australian cohort members to the mortality and cancer data held in the NDI and ACD.

When the mortality of occupational cohorts is compared with that of the general population, the mortality rate in the occupational cohort is typically lower. This is known as the *healthy worker effect* (29). One cause of the healthy worker effect is the relative social and economic advantage of employed people. Unemployed people on average tend to have lower socioeconomic status which commonly correlates with lower income, fewer years of education, lower health status and higher age-adjusted mortality rates than employed people. In addition, people with life-threatening conditions, such as cancer and other chronic illnesses, are less likely to enter the workforce, further lowering the mortality rate in the workforce compared with the general population.

A related "*healthy hire*" effect is likely to be particularly evident in coal mine workers who are (in part) selected for work in this industry on the basis of their physical fitness. Mine workers who become ill may leave the workforce as they can no longer carry out this physically demanding job, this also contributes to the healthy worker effect. This cohort is sufficiently powered to allow internal analyses comparing sub-groups of coal mine workers. This is the most effective way to limit the impact of the healthy worker effect.

4.8 Significance

This study will help to identify whether there is excess cancer incidence and/or mortality among Queensland coal miners, specifically from lung cancer, chronic respiratory disease, CVD and suicide. If excess disease and/or deaths are identified, the analyses by site type, job, and technology will inform RSHQ where preventive measures should be targeted to reduce the long-term chronic burden of disease among coal mine workers in Queensland.

5. Data security, management and storage

Storage: A secure ACCESS™ database running on an SQL server will be established to store both the information about the individuals and the exposure data. Data from RSHQ will be sent to Monash University Centre for Occupational and Environmental Health (MonCOEH) via a preferred secure file transfer system called "CloudStor" [CloudStor is a service run by AARNet (Australia's Academic and Research Network)] (https://www.aarnet.edu.au/network-and-services/cloud-services/cloudstor/). The data will be uploaded into the database hosted in a critical red-zone, only accessible by a single remote console login. Access will be limited to MonCOEH staff working on the study and will require a password login. Data will be regularly backed up.

Data Flow: RSHQ will provide content data to create an occupational cohort. The Monash Data Manager (who will not access the analysis dataset) will:

- help to prepare and clean the cohort file (RSHQ data)
- create two files: 1) New, study-specific Coal Miner (CM) ID and personal identifiers; 2) CM ID and RSHQ content
- send file 1) to AIHW using secure file transfer
- ensure files 1) New, study-specific Coal Miner (CM) ID and personal identifiers; and 2) CM ID and RSHQ content are stored separately
- ensure file 1) is not accessed by researchers conducting the analyses
- undertake data discrepancy checks on NDI linkage results (e.g. cancers after death, cancer deaths with no cancer diagnosed) and return verified CM ID to AIHW
- undertake data discrepancy checks on ACD linkage results (e.g. cancer matches different states, cancer death, no death match, job history). Seek additional information from RSHQ.
- provide additional information from RSHQ to AIHW for uncertain ACD CM IDs
- help to carry out a clerical review for the NDI using the identifiers provided by AIHW

- provide analysts with de-identified data file containing NDI and ACD data with CM ID for merging with RSHQ content

The AIHW will:

- using linkage spine, dedupe personal identifiers for each CM ID. Assign AIHW PPN if duplicates found
- if duplicates, send concordance CM ID and AIHW PPN to Monash Data Manager
- return personal identifiers, linkage weights, date of death, state/territory in which death registered, year of death registration and CM ID to Monash Data Manager for clerical review of NDI linkages
- receive from Data Manager a list of CM IDs that may be missed or incorrect NDI matches based on above Monash discrepancy checks. Re-link to NDI and confirm any new matches.
- return a list of CM IDs to Monash Data Manager of possible borderline ACD matches that require further information (e.g. post code) along with linkage weightings.
- receive postcode from Data Manager for uncertain ACD links. Re-link to ACD and confirm any new matches.
- for each -verified NDI linkage, return NDI content data with CM ID to Data Manager
- for each ACD match verified by AIHW, return ACD content data with CM ID to Data Manager

Monash researchers will:

- help to prepare and clean the cohort file (RSHQ data only)
- help to carry out a clerical review for the NDI using the identifiers provided by AIHW
- not access personal identifiers after the AIHW data has been provided.
- analyse the de-identified data file provided by the data manger.

Access: Data will be stored on University managed secure and resilient infrastructure located in Australia that complies with all applicable data protection and privacy obligations. The data will be uploaded into the database hosted in a critical red-zone, only accessible by a single remote console login. Access will be limited to

MonCOEH staff working on the study and will require a password login. Data will be regularly backed up. The computers are in offices which are kept locked out of hours, in a building that is only accessible by a swipe card. All MonCOEH researchers are required to sign confidentiality agreements in relation to all research they undertake.

Archiving/Destruction: For quality control purposes, the electronic data will be preserved at Monash University for at least seven years after the project is completed, as is required under the Health Records Act 2001. Once the data are no longer needed, they will be destroyed under the supervision of the Chief Investigators or securely disposed according to the Monash University policy.

Data from RSHQ will be reviewed by the Monash research team and checked for any inconsistencies and missing data. When all data have been cleaned they will be sent by secure transfer to the AIHW for matching. The final matched data set will be analysed by a qualified researcher.

6. Privacy and confidentiality

Data will be kept confidential throughout the study period and at the conclusion of the study in accordance with the Australian Code for the Responsible Conduct of Research. At the conclusion of the storage period, the data will be securely destroyed, rendering the electronic data non-identifying. These non-identifying data will be archived in SQL but will be made available, upon request, in accordance with the data-sharing requirements of the major medical journals and granting bodies. There will be no contact with participants in this study. It is likely that many of the participants whose data are being used in this study will have completed their work in the mining industry.

We have set up an Advisory Group including members from the RSHQ, mine operators, and the Construction Forestry Mining and Energy Union (CFMEU) and the Australian Workers' Union (AWU). The Advisory Group has supported a request for a waiver of individual consent from the Human Research Ethics Committees (HREC). Queensland State regulations allow the use of these identified data for research and surveillance purposes.

Members of the Advisory Group help to promote the study and to facilitate dissemination of the findings.

We will explain the study to the Advisory Group including that identifiable data will be submitted to the Australian Institute of Health and Welfare (AIHW) so that linkage to the NDI and ACD can take place. The content data will be provided to the research team, by the AIHW, in a format where their identifiable data (e.g. name and address) have been removed.

All data will be reported in a de-identifiable and aggregated format so that individuals will not be able to be identified. Any quotes reported from qualitative data will not identify individual persons.

7. Data analysis

There are two main ways to analyse the cohort data:

- The Standardised Mortality Ratio (SMR) and 95% Confidence interval (95% CI) and Standardised cancer Incidence Ratio (SIR) and 95% CI which compare the cohort data with the Australian population;
- The rate ratio (RR) and 95% CI which compare groups within the cohort.

The SMR compares the actual number of deaths from a particular cause in the cohort with the expected number of deaths in the cohort if the death rate in the cohort was the same as that of the general Australian population. To find the expected number of deaths, we calculate the number of person years in the cohort grouped by age group and calendar time, and project the Australian death rates to this population. The actual number of deaths is divided by the expected number of deaths to calculate the SMR. Similar calculations will be made for incident cancers to calculate an SIR. The 95% confidence intervals will be calculated.

The RR compares the rates between various subgroups within the cohort. Subgroups will be based on types of mine site, job group, and exposure duration or exposure intensity. Each rate will be calculated by dividing the number of deaths or incident cancers in that group with the number of person-years in the same group. One group (usually the lowest exposure group) is the comparison group, and the rate ratio for each of the other groups is calculated as the rate in each group divided by the rate in the comparison group. Such internal comparisons can only be done where there are sufficient numbers of cancer and mortality events in the groups being compared. The advantage of internal comparisons is that they can be adjusted for smoking and they help to overcome the healthy worker effect, that is those in work are, on average, healthier than those not in work.

One set of analyses, will be carried out on only the 71,700 coal mine workers with more than one health assessment because they will have worked for at least five years. All analyses will be carried out in Stata separately for men and women and will be adjusted for age and calendar year.

Our power calculations below are based on the smaller number of 71,700 coal mine workers with more than one assessment, the power will obviously be much higher for the full cohort of 180,300 people. All calculations are at 5% significance, and show the study to be sufficiently powered for men to detect a 20% increase in any of: all cancers, all-cause mortality and deaths from CVD. We anticipate that, for men we have over 95% power to detect a 20% increase in both lung cancer incidence and non-malignant respiratory causes of death. We will have 60% power to detect an increase of 20% in less common cancers in men, such as leukaemia, bladder or kidney cancer and over 99% power to show a 50% increase in these cancers.

There is less power to look at the risks for the smaller group of women in the cohort who have been employed for at least five years. There is about 90% power to show a 20% increase in all-cause mortality and all cancers in women and 57% power to detect a 20% increase in deaths from CVD. We will have 64% power to detect a 50% increase in women in non-malignant respiratory causes of death and 92% power to detect a 50% increase in breast cancer and 53% for lung cancer incidence. With a longer follow up, the power to detect increases in the rarer cancers and causes of death. Once the cohort has been established it is relatively cheap to rematch and re-analyze the risks when more person-years have accumulated.

Sub groups of the cohort will be examined by:

Duration in the industry: in internal analyses, we will compare the health of those with less than five, five, ten, and more than ten years in the industry.

Start date in the industry: differences in risk by era can be examined, so that the effect of changes in technology can be investigated e.g. examining the risks for those employed only after the introduction of bi-directional cutting.

8. Administrative procedures

8.1 Collaboration

DNRME and MonCOEH have already collaborated on three DNRME-funded projects. The research team have collaborative links with each other including with Al Cliff who chaired the Advisory Committee of the Black Lung Review, has extensive experience in the mining industry in Queensland and a good relationship with RSHQ.

8.2 Protocol compliance

The instructions and procedures specified in this Protocol require attention in their execution. Should there be questions or consideration of deviation from the Protocol, clarification will be sought from the CIs. The nature and reasons for any Protocol deviation will be recorded.

8.3 Archives: retention of study records

For quality control purposes, the data will be preserved at Monash University for at least seven years after the project is completed, as is required under the Health Records Act 2001. Once the data are no longer needed, they will be destroyed under the supervision of the Chief Investigators or securely disposed of according to the Monash University policy.

8.4 Ethical review

The study has obtained approval from the Monash University Human Research Ethics Committee, from the cancer registry HREC for each state and territory and from the AIHW HREC.

The Protocol has been submitted to the appropriate Ethics Committee, and written approval was obtained before data is obtained from RSHQ. A copy of the Monash approval was transmitted to the RSHQ before starting the study. If approval is suspended or terminated by the Ethics Committee, A/Prof D Glass will notify the RSHQ immediately.

The Principal Investigator will ensure that study progress is reported to the HRECs as required or at intervals not greater than one year.

The Principal Investigator, or her nominee, will be responsible for reporting any serious adverse events to the Ethics Committee as soon as possible, and in accordance with the guidelines of the Ethics Committee.

8.5 Protocol amendments

No amendments to the Protocol may be implemented without prior approval from the Monash HREC. Once the final Protocol has been issued and signed by the Investigator and the authorised signatories, it will not be informally altered. It is the responsibility of the Principal Investigator to submit an amendment to the Ethics Committee for their approval. The original signed copy of amendments will be kept in the Study File with the original Protocol.

8.6 Quality assurance

The Study team is responsible for monitoring adherence to the Protocol and completion of the study, and for maintaining collaborative relationships with the RSHQ.

8.7 Communications

Internal meetings are held on a regular basis and the minutes are kept in the folder at S:\MNHS-SPHPM-EPM\MonCOEH\Queensland DNRM\2018 DNRM Cohort study\Meetings Internal on the DEPM shared password protected secure computer network.

External meetings/teleconferences between the investigators and RSHQ representatives are held regularly. Email and verbal reports to the Advisory Group and to RSHQ will be provided. Teleconferences may be held between the study team, RSHQ and members of the Advisory Group as necessary.

RSHQ and study team at Monash are responsible for arranging and minuting the Advisory Group meetings. Minutes of meetings with the Advisory Group are kept in the S:\MNHS-SPHPM-EPM\MonCOEH\Queensland DNRM\2018 DNRM Cohort study\Meetings\External folder on the DEPM computer network.

9. Study timelines

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10. Reporting the results

MonCOEH investigators will provide a report to RSHQ on the findings and a plain language statement for the Advisory Group members including the CFMEU to distribute to its members. These reports will not identify any individual mine worker, nor any individual mines.

We anticipate a number of publications in the peer reviewed literature around the cancer and mortality findings in men and notably in women and the effect of adjusting for smoking. In these papers we should make a substantial contribution to the literature on health impacts in coal mine workers. This is because of the large size of the cohort, the strength of the death and cancer linkage in Australia, the ability to include analyses of a substantial number of women, the individual smoking data and the inclusion of comprehensive air monitoring data for a wide range of hazards. These have been limitations in much of the previous literature on cancer and causes of death in coal mine workers.

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