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HEALTH SERVICE USE AND RETURN TO WORK PATHWAYS OF INJURED WORKERS IN THE NEW SOUTH WALES COAL MINING INDUSTRY

ANALYSIS OF PAYMENT AND CERTIFICATE DATA

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EXECUTIVE SUMMARY

Previous studies have shown that workers in the coal mining industry are at a higher risk for work-related injury and illness. Whilst the incidence of injury has been decreasing over time due to improved occupational health and safety measures, the duration of absence following a work-related injury has been increasing. In the event of work-related injury or illness, a worker may claim workers' compensation which may support recovery through provision of health and other services, and income support whilst absent from work. The focus of this report was to understand the patterns of health service use and the return to work pathways, and factors associated with each of these.

The most commonly utilised service provider was a General Practitioner (GP), with physical therapists also common. A quarter of all health service use occurred in the first month after injury, three-quarters in the first 12 months, and only a small portion having long-term service use. Within that first month ambulance and hospital services were most commonly used. Physical therapy services were used steadily over the first 12 months and return to work services were engaged with commonly from six months. Psychological services became more prevalent over time. Traumatic injuries had a high volume of use in the first month, whereas for more chronic conditions such as neurological conditions services were continuing to be utilised later. Engaging with specialists occurred over a longer duration than other services.

Using latent class analysis, claims were grouped into low, medium or high health service volume groups depending on their interactions with health services. There were no large discrepancies in ambulance or hospital service usage between groups, however there were noticeable increases in predicted counts with increasing volume for physical therapy, GP, specialist and return to work services. Females were more likely to be in higher volume groups as were older age groups and workers with upper body and multiple location musculoskeletal conditions. Time loss claims were also more likely to be in the higher volume groups.

Overall there was delayed first return to work with increasing age and among those with mental health and neurological conditions. Traumatic injuries had the shortest time to first return to work. With increasing health service use volume there was slower first return to work. Both attempting and having a successful graduated return to work (no relapse) was a relatively common pathway. However, around a quarter experienced at least one relapse (from pre-injury duties to modified duties/hours or modified duties/hours to full absence).

There were some consistent patterns with groups having more or less successful return to work pathways. Workers with fractures had higher odds of successful graduated return to work and full return to work. With increasing age there were generally poorer return to work outcomes (higher odds of relapse and no return to work). Similarly, with increasing health service use volume there were higher odds of relapse and no return to work, and despite higher odds of attempting graduated return to work there were lower odds of a successful graduated return to work.

KEY MESSAGES

Results have shown those more likely to engage particular health services and the volume of use, as well as the pathways taken to return to work, whether that be pre-injury duties or on permanent modified duties, or not at all. There are definite age-related patterns to health service use and return to work, as well as other injury-related factors.

Results highlight opportunities for tailored support for injured workers. By understanding the factors associated with particular health service use and return to work patterns, injured/ill workers who might require and benefit from additional support can be identified or flagged early in the claim to help recovery. For example, psychological support may be offered early in the claim to those deemed at risk of long-term and/or high volume of service use or work absence to address barriers to recovery. Further qualitative analysis would be worthwhile to understand why some workers have a delayed return to work or a high volume of health service use beyond what is expected for their condition.

PURPOSE

The purpose of these analyses was to describe the health service use and return to work patterns of injured workers in the coal mining industry. Specifically, the study sought to 1) describe the timing and patterns of health service use of injured workers in the coal mining industry and the association of demographic, injury and claim factors with health service use; 2) describe the return to work pathways followed by injured workers and the factors associated with time to first return to work and the various return to work pathways, and; 3) determine how health service use is associated with return to work.

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OVERVIEW OF THE PROJECT

RATIONALE

Previous reports have found that workers in the coal mining industry face a number of injury and illness hazards, and are therefore at risk for a wide range of work-related conditions [1, 2]. Hazards include but are not limited to falls, manual handling, exposure to hazardous vibration, sometimes cramped or uncomfortable conditions, being hit by machinery or moving objects, and exposure to consistent background noise. The work-related conditions vary from traumatic injuries to musculoskeletal conditions to neurological conditions such as hearing loss, among others. At an individual level, worker injury can result in changes to physical and mental health and quality of life, and extended periods of reduced work capacity can have a negative impact on health [3]. Health service utilisation and return to work pathway analysis are two areas with potential for improving the health and return to work outcomes of the injured worker.

In particular, among the New South Wales coal industry, musculoskeletal conditions were most common (52.4%) followed by traumatic injuries (26.7%) [4]. The upper body was most commonly affected. For musculoskeletal and neurological conditions, the incidence of claiming increased with age up to 65 years. Falls, body stressing, being hit by moving/falling objects and long-term exposure to sounds were the most common causes of injury. With increasing age there was significantly increasing duration of time loss, with musculoskeletal conditions having the longest durations of absence.

Encouragingly, however, it appears that likely due to industry-wide improvements to occupational health and safety, the overall incidence of injury and illness is decreasing both internationally (determined through review of the literature) and nationally (determined through literature review and analysis of claims data) [1, 2]. Despite this, there have been reports of increased work absence after work-related injury or illness, which has far-reaching implications for health of the workers, their employers, and the systems that support them [1, 4, 5]. However, the overall burden of injury (a measure combining incidence of injury and duration of time loss) is not significantly changing [4].

In the event of a work-related injury or illness, workers may submit a workers' compensation claim to help support their recovery. Workers' compensation may support an injured/ill worker through provision of health and other services, and income support whilst absent from work. Specifically, these entitlements may be in the form of medical and ancillary expenses (where necessary), occupational rehabilitation services, weekly payments for loss of income during work absence, and other reasonable expenses such as travel.

Previous analysis showed that the likelihood of engaging particular services varied by sex, age and condition type [4]. Females were more likely to engage all services. In general, with increasing age up to 65 years there was increased likelihood for most services. The treating doctor was the most commonly seen specific service for all conditions. Allied health and x-rays and scans were commonly used by those with fractures and musculoskeletal conditions, with x-rays

and scans also common among those with traumatic injuries. Workers with neurological conditions commonly engaged with artificial aid services (including hearing aids).

Cost analysis showed that musculoskeletal conditions, in particular those to the upper body, were most expensive [4]. Specialist costs for this group were the highest of all costs, with specialists representing the highest cost for all conditions except neurological conditions, which was artificial aids (79.3% of all costs for those with neurological conditions). Most costs have fluctuated over time however for private hospitals there was a steadily increasing trend from 2010 to a peak in 2015, where it has since been declining.

Previous findings have shown the type of injuries and illnesses workers in the coal mining industry face, their causes, the bodily locations affected, the length of absence following the injury/illness, the types of services engaged with during recovery and the costs of these services. It is important now important to understand the varying health service use and return to work patterns of different workers to determine any characteristics that may allow tailored support to be provided. For example, do those with considerable use of health services require greater support to return to work? This is the focus of this report.

OBJECTIVES

In order to provide detailed information on the health service use and return to work patterns of workers in the coal mining industry, the following research objectives will be examined:

1. To describe timing and patterns of health service use by workers following work-related illness and injury.
2. To determine the associations between demographic, injury nature and claim factors and health service use patterns.
3. To describe the return to work statistics by characteristic.
4. To describe the return to work pathways followed by injured workers.
5. To determine factors associated with time to first return to work.
6. To determine factors associated with various return to work pathways.
7. To determine the relationship between health service use and return to work.

METHODS

DATA SOURCES

Payment-level data were provided by Coal Mines Insurance. Payments were included if they occurred up to 30th November 2020 from claims that occurred between 1st July 2004 and 1st July 2020. These payments were linked with the originally supplied claims data from Coal Mines Insurance (see Descriptive Analysis Report [1]).

DATA PREPARATION

MEDICAL DATA

The medical dataset contains data on services used by injured workers for which a payment has been recorded, including the service date, type of service and amount paid by the Coal Mines Insurance scheme. Where there were multiple records with duplicate values for the variables 'Claim', 'PH_PayCodeDesc', 'DateTo' and 'DateFrom', only one record was retained, to avoid overestimating health service use. It was assumed unlikely that an individual would use the same service on the same day.

Services were limited to those which involved patient-provider interaction, and were excluded if the description indicated there was no direct engagement between patient and provider. To determine patient-provider interactions, the descriptions 'PH_PayCodeDesc' and 'WCA_AMA_Description' were screened. First, observations were excluded where the 'PH_PayCodeDesc' category indicated no engagement between patient and healthcare provider (e.g. 'Health club or pool memberships', 'report fees'). The remaining categories for 'PH_PayCodeDesc' were then assessed in conjunction with the corresponding description for 'WCA_AMA_Description' (e.g. for the 'PH_PayCodeDesc' category 'psychological services', observations were excluded where the WCA_AMA_Description was 'report writing' or 'travel', and retained where the description was 'standard consultation' or 'initial consultation'). Where 'WCA_AMA_Description' was missing, the observation was included, as the highest frequency of 'PH_PayCodeDesc' for each category had a corresponding blank value for 'WCA_AMA_Description'. Observations were then classified into nine categories of service type, based on the payment subcategory descriptions and grouped by the type of service provided. These nine categories and the payment subcategory descriptions of which they are comprised are presented in Table 1 below.

The medical dataset was merged with the original claim dataset, to enable the inclusion of claim and demographic information, including the date of injury which was vital for health service use analysis. To ensure adequate and consistent follow-up time for all claims, services were right-censored at three years from the date of injury ("date occurred").

Table 1 – Service type categories and their included payment subcategory description

Service Type	Payment subcategory description included
Ambulance	Ambulance fees
Artificial Aids	Artificial aid/related treatment Hearing aid/assessment Hearing assessment/aids
Physical Therapies	Chiropractic Physiotherapy Remedial massage or exercise physiology Remedial therapy
General Practitioner	General practitioner
Hospital	Hospital accounts/expenses
Return to work	Occupational rehabilitation Vocational retraining
Specialist	Specialist consultation
Psychological services	Psychological services Counselling fees
Other services	Imaging service Dental service

WORK STATUS DATA

Due to the lower number of unique claim identifiers in the weekly benefit payment dataset, the decision was made to solely use the work status dataset to describe return to work patterns. The work status dataset is an aggregated dataset of certificate and work status data. The data includes information on whether on the 'EffectiveDate' the worker had 'CeasedorResumed' working in any capacity and the type of certification and/or working status. The 'lastCertSeqNo' variable was used to determine the most recent change in work status where an 'EffectiveDate' date may have been the same for a claim (possibly entered on the same day). The following 'FitnessStatusCode' variables were considered absent from work: graduated return to work not available (GRTW_NOT_AV), permanently modified duties not available (PMD_NOT_AV), suitable duties not available (SD_NOT_AV), totally unfit (TOTAL_UNFIT) and unknown ceased work (UNKNOWN_C). A 'FitnessStatusCode' of one of the following was considered to have resumed working: common law (C_LAW), graduated return to work available (GRTW_AV), permanently modified duties available (PMD_AV), suitable duties available (SD_AV), retired (RETIRE), pre-injury duties (PREINJURY) and unknown resumed work (UNKNOWN_R). These were re-classified as per Table 2.

Note that 'partial' return to work refers to all accommodations, whether they were reduced hours, alternate or modified duties, or a combination of both. Codes of GRTW_NOT_AV, PMD_NOT_AV and SD_NOT_AV meant the worker had capacity but there were no available alternate/modified duties available from the workplace.

Table 2 - Reclassification of fitness status codes

FitnessStatusCode	New Code
TOTAL_UNFIT UNKNOWN_C	A (absent)
GRTW_NOT_AV PMD_NOT_AV SD_NOT_AV	C (capacity to work but not working)
GRTW_AV PMD_AV SD_AV	P (partial return to work)
PREINJURY UNKNOWN_R	F (full return to work)
C_LAW	L (common law)
RETIRE	R (retirement)

To determine the number of days until first return to work, the difference between the injury date and the earliest date where the worker had 'resumed' working (using 'CeasedorResumed' variable) was recorded. If the worker did not have any 'resumed' codes within the work status dataset, there was no return to work. Similarly, to determine the number of days until the last/most recent return to work, the difference between the injury and the latest date where the worker had 'resumed' working was recorded. In most cases this was the same number of days as the first return to work.

For each claim, the 'CeasedOrResumed' value at the most recent date was recorded to determine the last state (at time of data extraction).

Figure 1 shows the many return to work pathways that workers may take. After an injury, a worker may have no absence, partial absence (through part-time hours, modified duties, or a combination), or full absence. From full absence, a worker can undergo a graduated return to work pathway and commence partial duties prior to a full return to work, or return directly to pre-injury duties, or relapse. From initial partial absence, a worker may remain at permanently partial duties or return to full duties, or relapse. A relapse is defined as a backwards step in the return to work pathway in that rather than increasing duties or hours over time, there is a setback causing them to revert back to a previous return to work state. Using the diagram, moving to the right (green arrows) is considered moving forward and moving to the left (red arrow) is considered a relapse. For example, a worker may have full absence after injury then return to pre-injury duties, however this may be too much for them at the time and they must return to full absence or partial absence before progressing again.

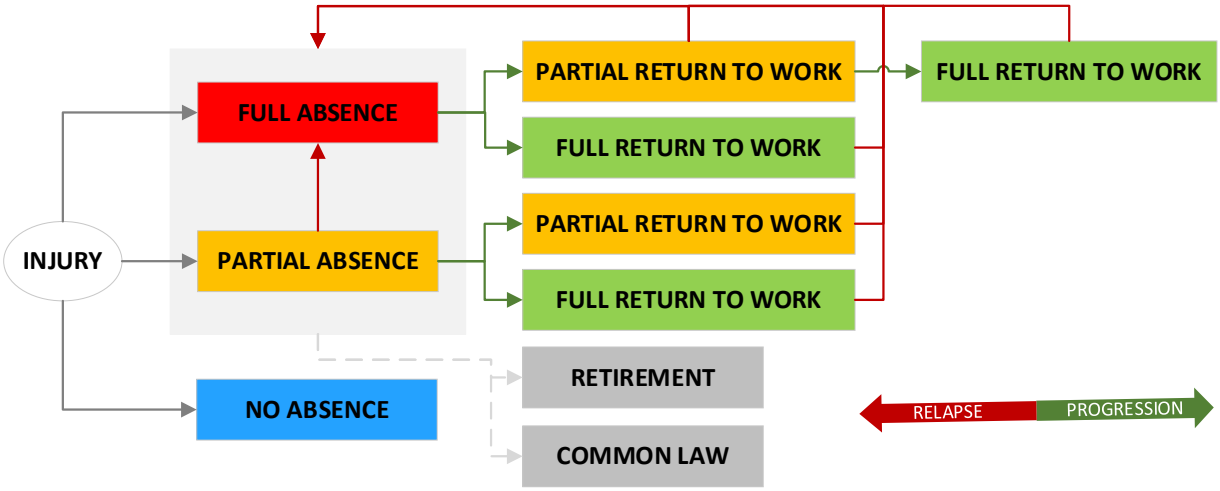

Figure 1 - Return to work pathways: concept diagram

To determine the return to work pathways of workers, the order of work statuses was determined using earliest to latest 'EffectiveDate'. In instances where 'EffectiveDate' was the same for the same Claim ID but with a different work status, the maximum 'last'CertSeqNo' was used (see below example in table 3). The new work status codes were combined into a sequence based on date order, and then further collapsed for repeating letters as this meant there was no change in work status.

Table 3 - Explanation of determining return to work pathway

ClaimID	EffectiveDate	lastCertSeqNo	WorkStatus
ABC123	1/1/2015	1	A
ABC123	7/1/2015	3	P
ABC123	7/1/2015	4	F
ABC123	1/2/2015	7	P
ABC123	11/2/2015	8	P
ABC123	19/2/2015	9	F
XYZ789	17/7/2016	1	A
XYZ789	18/8/2016	4	A
XYZ789	3/11/2016	8	A
XYZ789	30/11/2016	9	F

⇨

Original Sequence	Collapsed Sequence
AFPPF	AFPF
AAAF	AF

Patterns in the collapsed sequences were detected to determine the type of return to work pathways (see Table 4).

Table 4 - Definition of return to work pathways

Return to work pathway category	Sequence
No absence	'F' only
Full return to work (without relapse)	'AF' only
Partial return to work only	'AP' or 'P' only
Graduated return to work (without relapse)	'APF' or 'PF' only
No return to work	'A' only
Relapse	Any of 'FA', 'PA', 'FP', 'FC' or 'PC' within collapsed sequence
Retirement	Included 'R' within collapsed sequence
Common law	Included 'L' within collapsed sequence

PREDICTOR VARIABLES

For health service use, demographic (sex and categorised age group) and injury (combined injury and bodily location) factors were factored in as predictor variables into analysis [1]. Similarly, for return to work analysis, sex, categorised age group, condition type, bodily location of condition and health service use volume (see Analysis Strategy – Health Service Use).

OUTCOME VARIABLES

HEALTH SERVICE USE

The main outcome was health service use, for which the frequency, prevalence, timing, and volume across the nine categories of health service use outlined earlier was examined (Table 1). Frequency was determined by the number of unique claim IDs using a service. The prevalence of service use was calculated to explore the proportion of workers who had used a health service at any time during the study period. Prevalence of service was calculated for all workers who used at least one health service using the following formula:

$$Prevalence\ (of\ service\ users) = \left(\frac{number\ of\ workers\ utilising\ specific\ service\ type}{number\ of\ workers\ who\ used\ at\ least\ one\ health\ service}\right) \times 100$$

The prevalence of health service use among all workers with a claim (i.e. regardless of whether or not they used a health service) was also calculated, using the following formula:

$$Prevalence\ (of\ all\ claims) = \left(\frac{number\ of\ workers\ utilising\ specific\ service\ type}{number\ of\ workers\ with\ a\ compensation\ claim}\right) \times 100$$

Timing of service use was based on the difference in months between the date the injury or illness occurred, and the first service period end date - based on the value of the 'DateFrom' variable. Duration of service was defined as the length of time between the first service use (the earliest 'DateFrom') and the most recent service use which occurred within the three-year follow up period. The volume of service use was determined by number of times a service was used for each unique claim ID within a three-year follow-up period.

RETURN TO WORK PATHWAYS

The time to first return to work was generated using the difference between date of injury and the earliest date where the worker had 'resumed' working (using 'CeasedorResumed' variable). This variable was used as the outcome for Cox regression when determining factors associated with time to first return to work.

Binary flags were created for whether the following pathways were followed: full return to work, successful graduated return to work, relapse, any attempt at graduated return to work (any transition from 'A' to 'P'), and no return to work. These flags were used as the outcome variables in separate regression models in logistic regression.

ANALYSIS STRATEGY

HEALTH SERVICE USE

For the health service use analysis, only claims with an injury date range of 1/07/2004 to 31/12/2017 were included, and their corresponding health service payment records up to 3 years weeks post injury. Descriptive analysis was first performed to examine the number of workers using health services for each health service category, and presented in a table alongside prevalence. Two estimates of prevalence were provided with both presented as percentages.

The timing of health service use in terms of how much time (in months) had passed from date of injury/illness occurrence to service use was explored, with results presented in two figures. To examine the total duration of service, the total, median and range of service use in months for each service type was calculated and presented in a figure.

The volume of service use was presented in a table displaying the mean (SD) and median (IQR) number of services used for each health service use category where at least one service was used.

Latent class analysis was performed to classify individual claimants into distinct subtypes of health service user. Latent class analysis is a method which can be used to identify unmeasured groups ('classes') to which an individual can be categorised, based on the information available in other variables. Three classes were identified, and characterised according to volume of health service: low, medium and high. The number and column percentage of claims for each of the three classes was presented in a table by demographic, injury and claim factors. Multinomial logistic regression was performed to assess the relationship between membership of a particular class of health service volume and the predictors sex, age and combined injury and bodily region predictor. The results are presented in a table with adjusted relative risk ratios and corresponding 95% confidence intervals.

RETURN TO WORK PATHWAYS

Descriptive statistics were presented in a table of the number of claims and column percentages by predictor variables sex, age, nature of injury and bodily location of injury, as well as the median number of days to first and last return to work (with corresponding interquartile ranges), the proportion within each group for working or not working as the return to work state at time of data extraction, and with the proportion within each group that had no return to work.

The proportion of the cohort that followed each return to work pathway was presented in a figure. Additional proportions of those that relapsed as well as those that had certified capacity to work but were not working were also presented.

Cox regression was performed to determine the association of predictor variables on the time to first return to work. Regression was performed twice, the first model included the predictor variables sex, age, injury type and bodily location and the second model included the additional health service use volume variable. Results of both models were tabulated and presented as hazard ratios with corresponding 95% confidence intervals. A survival curve was generated showing differences by health service use volume group.

Multivariable logistic regression was used to determine the likelihood of experiencing the following binary outcomes: full return to work, (successful) graduated return to work, no return to work, any attempt at graduated return to work, and relapse. Two regression

models were generated for each binary outcome, the first with sex, age, injury type and bodily location as predictors and the second with the additional health service use volume group predictor. Results were presented as forest plots displaying odds ratios with corresponding 95% confidence intervals and in table format in the Appendix alongside frequency, proportion of cohort and row percentage (proportion of each predictor variable). For those regressions with outliers (relapse and attempted graduated return to work), forest plots were generated twice with the second plot showing odds ratios on a $\log_{10}$ scale for clearer presentation.

RESEARCH FINDINGS

HEALTH SERVICE USE

DESCRIPTIVE STATISTICS

There were 25,003 unique claims that used at least one health service. Table 5 shows that the most frequently used service type was General Practitioner (GP) (N = 18,113, 35.0%), followed by physical therapies (N = 9,528, 18.4%) and hospital (n=6,369, 12.3%). This table also shows little variation in terms of column percentage and prevalence for each service type when service use is limited to only those used within three years of the date injury or illness occurred.

Table 5 - Frequency, proportion and prevalence of claims by health service category

Health Service Category	All claims				Within three years follow-up			
	N	Col. %	Prevalence - all claims	Prevalence - claims with health service use	N	Col. %	Prevalence - all claims	Prevalence - claims with health service use
Ambulance	3,116	6.0	11.4	12.5	3,095	6.1	11.3	12.4
Artificial Aids	4,903	9.5	17.9	19.6	4,685	9.2	17.1	18.7
Physical Therapies	9,528	18.4	34.9	38.1	9,416	18.5	34.5	37.7
GP	18,113	35.0	66.3	72.4	18,022	35.4	65.9	72.1
Hospital	6,369	12.3	23.3	25.5	6,231	12.2	22.8	24.9
Return to Work	2,784	5.4	10.2	11.1	2,672	5.3	9.8	10.7
Specialist	6,182	11.9	22.6	24.7	6,064	11.9	22.2	24.3
Psychological Services	259	0.5	0.9	1.0	216	0.4	0.8	0.9
Other Services	544	1.1	2.0	2.2	490	1.0	1.8	2.0
Total	51,798	100			50,891	100		

TIMING AND DURATION OF HEALTH SERVICE USE

Table 6 displays the timing of health service use for all health service types combined. Approximately a quarter of all health service use occurred within one month of the date of injury or illness (n = 81,246, 25.9%). Health service use frequency was lowest in the 25-36-month category.

Table 6 - Timing of health service use (months)

Timing of health service use (months)	N	col %
1 month	81,246	25.9
2-3 months	59,340	18.9
4-6 months	49,259	15.7
7-12 months	53,514	17.0
13-24 months	46,888	14.9
25-36 months	24,199	7.7
Total	314,446	100.0

Figure 2 shows the density of each type of health service use for injured coal mining workers after their injury occurred. Overall, ambulance use peaks at the most acute period post injury and then drops significantly. The use of artificial aids, hospital and GP services peaks between 1-2 months after illness or injury occurred. Physical therapies and specialist services also peak within the first two months after injury but declines steadily up to the 3-year follow-up period. The use of return to work and psychological services tend to peak at the sub-acute period post injury. There was less use of psychological services within the first 2 months after injury occurred, increasing slowly and then remaining stable.

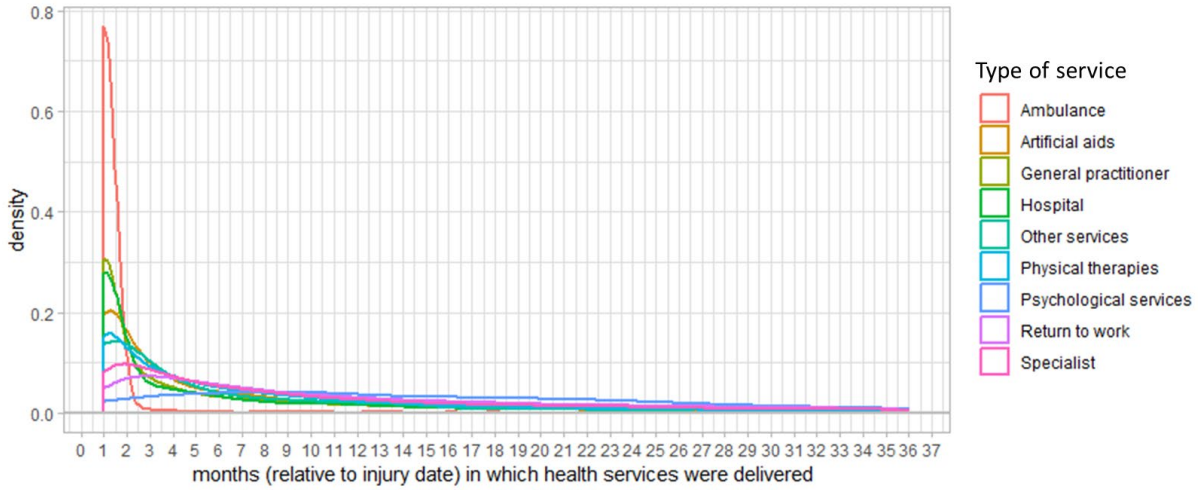

Figure 2 - Months in which health services were delivered to injured workers by service type

Figure 3 further demonstrates the distribution of each service use across six time periods: 1 month, 2-3 months, 4-6 months, 7-12 months, 13-24 months and 25-36 months after injury. For most service types, the frequency of service use appeared to decrease with time after injury, except for return to work and specialist services, which appeared to increase as the timing of service use increased. Other exceptions to this trend were psychological services – which increased in frequency with time only until the 25-36-month mark – and GP services, for which there was a decrease at 4-6 months, followed by an increasing frequency at subsequent time points.

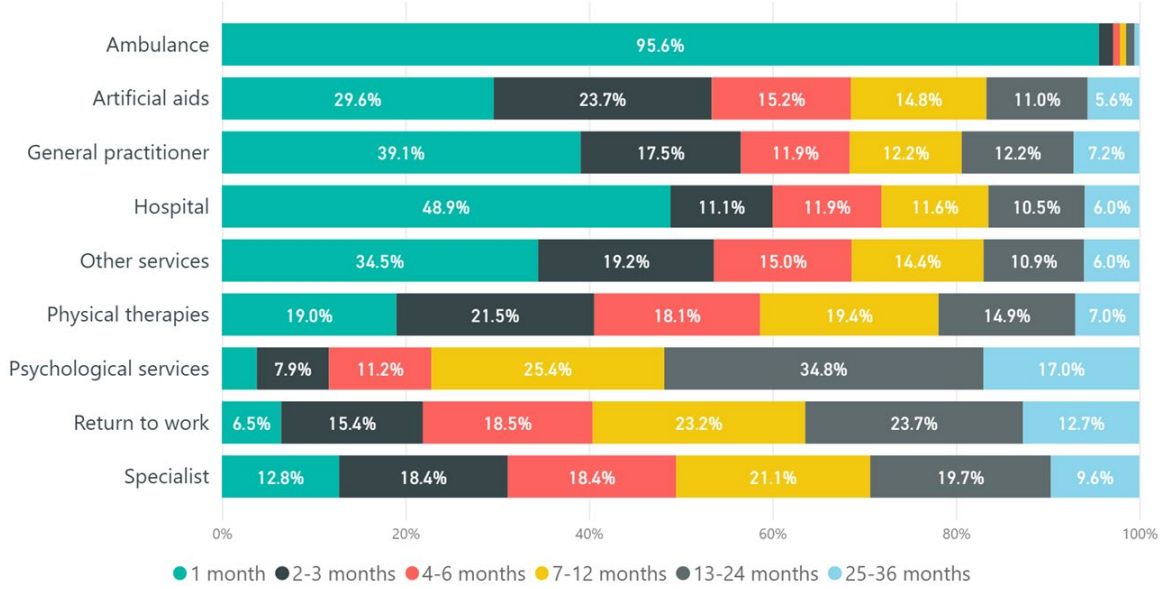

Figure 3 - Timing of delivery of health service use relative to the date injury occurred by service type

Figure 4 shows the density of health service use for major types of injury among injured coal mining workers after their injury occurred. In brief, there was a similar pattern of health service use for all types of injury in that health service use peaked early then declined with time.

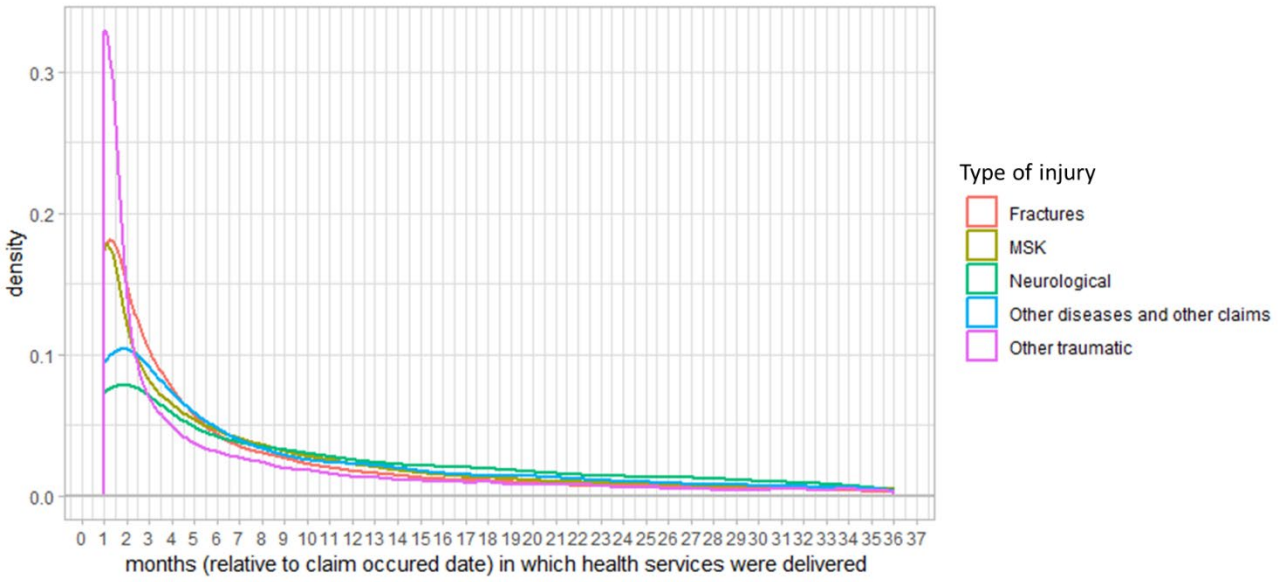

Figure 4 - Months in which health services were delivered to injured workers by injury type

As shown in Figure 5, around 43% of the health service use for other traumatic injuries occurred within the first month, and around 20% for fractures, musculoskeletal conditions, neurological conditions and other diseases and other claims. However, neurological injury had a higher proportion of health service use in the persistent phase beyond 6 months post injury compared to other conditions.

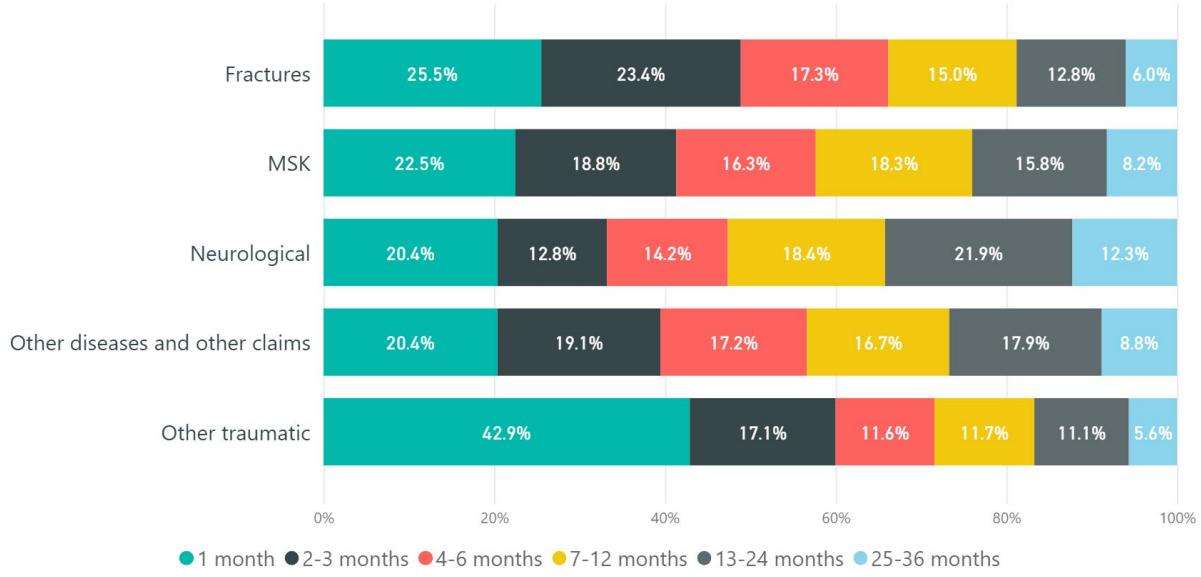

Figure 5 - Timing of delivery of health service use relative to date of injury occurred by injury type

Figure 6 shows the median duration for health service use by service type in the 3-year follow-up period. The median duration of return to work (4 months, IQR 2-10) and specialist services (3 months, IQR 0-9) were significantly longer than other service types. Ambulance, hospital and psychological services were less likely to be used over a period of time.

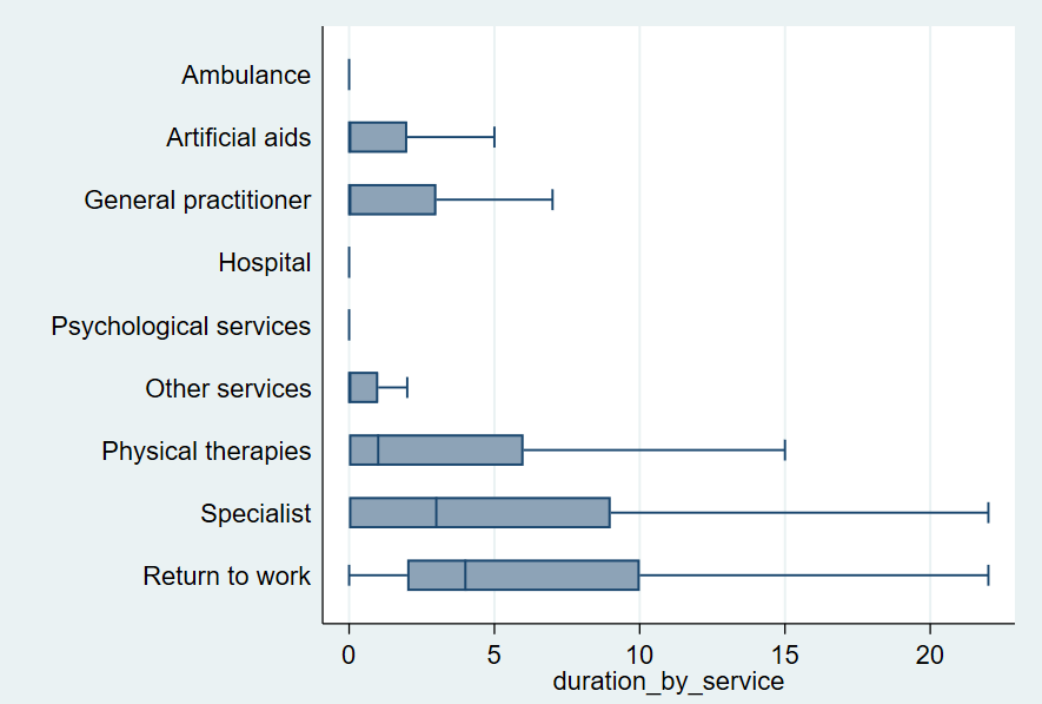

Figure 6 - Duration of health service use by service type

Note: Box represents the 25th and 75th percentile of the duration of service use for each service type, with the median indicated by the vertical line within the box. The whiskers at each end of the line represent the lower and upper adjacent values (within 1.5 IQR of median), demonstrating the range of values observed for each service type.

PATTERNS OF HEALTH SERVICE USE

Table 7 shows the mean and median service use by service category, where each service category was used at least once. Physical therapies had the highest mean number of uses (mean 13.7), followed by return to work services (mean 11.5). Physical therapies also had the widest interquartile range (median 7, IQR 3-16). Ambulance services had the lowest mean number of uses (1.0), as well as the lowest median and IQR (1, 1-1).

Table 7 - Mean and median service use by health service category where at least one service was used

Health Service Category	Mean* (SD)	Median* (IQR)
Ambulance	1.0 (0.2)	1 (1-1)
Artificial Aids	2.5 (3.2)	1 (1-3)
Physical Therapies	13.7(20.2)	7 (3-16)
GP	5.5 (7.6)	3 (2-6)
Hospital	1.7 (2.0)	1 (1-2)
Return to Work	11.5 (11.8)	8 (4-15)
Specialist	4.6(5.4)	3 (2-6)
Psychological Services	1.8 (3.0)	1(1-1)
Other Services	2.0 (2.0)	1 (1-2)

*these values represent the mean and median number of service uses among workers who used this service at least once

Latent class analysis was used to identify groups of injured coal mining workers with different patterns of health service use. This analysis suggests three classes of health service use. Table 8 shows the marginal predicted counts (means) or probability of the outcome within each group. Each of the groups are described as follows:

- Low Volume Group (Class 1). Workers in this class represent the lowest users of health services, with smallest average number of artificial aids, physical therapies, GP, return to work and specialist services and lowest probability of ambulance and hospital use. Workers in this group tend not to use psychological services. This group accounted for 66.9% of all workers that had at least one service use.
- Medium Volume Group (Class 2). Workers in this group were relatively medium users of all health services, with mean physical therapies of 9.90 and GP of 6.54 per worker. This group accounts for 25.4% of the cohort.
- High Volume Group (Class 3). Workers in this group were the most frequent users of artificial aids, physical therapies, GP, return to work and specialist services, and had the highest probability of ambulance and hospital use. Workers in this group are also more likely to access psychological services than workers in other classes.

Table 8 - Marginal predicted counts or probability and 95% confidence intervals by health service user group

	Low Volume Group (mean, 95%CI)	Medium Volume Group (mean, 95%CI)	High Volume Group (mean, 95%CI)
Ambulance*	0.16 (0.15-0.16)	0.13 (0.12-0.14)	0.21 (0.19-0.22)
Artificial Aids	0.09 (0.08-0.10)	1.04 (1.02-1.07)	3.27 (3.18-3.34)
Physical Therapies	0.53 (0.51-0.55)	9.90 (9.77-10.01)	45.11(44.71-45.51)
GP	2.19 (2.16-2.21)	6.54 (6.45-6.61)	23.43 (23.16-23.69)
Hospital*	0.22 (0.22-2.23)	0.38 (0.37-0.40)	0.78 (0.76-0.80)
Return to Work	0.02 (0.01-0.02)	1.58 (1.54-1.63)	14.40 (14.19-14.60)
Specialist	0.26 (0.25-0.27)	1.96 (1.91-2.00)	9.23 (9.10-9.40)
Psychological Services*	0.00 (0.00-0.00)	0.00 (0.00-0.01)	0.11 (0.10-0.13)

**Note*: Ambulance, Hospital and Psychological Services were included into the model as binary outcomes meaning that the numbers represent probabilities rather than predicted counts (e.g. 0.16 represents 16% probability).

Table 9 displays the number and percentage of claims for each of the service use volume categories identified in latent class analysis. The majority of claims were in the Low Volume category (n=13,551, 55.1%), with only 10.2% (n = 1,556) in the High Volume category. The table shows the proportion of females in each category increases as service use increases. The distribution of age categories appeared similar between the Medium Volume and High Volume categories, whereas the Low Volume use category appeared to have a greater proportion of younger workers with almost one third under the age of 35 years.

The majority of High Volume service and Middle Volume service users had a musculoskeletal upper body condition. When all musculoskeletal conditions were combined (lower body, upper body and other), they accounted for 78.6% of High Volume and 77.0% of Medium Volume service use claims. The lowest proportion of condition type for High Volume and Medium Volume were neurological conditions, accounting for 1.0% and 0.8% of all claims in these categories respectively. Other traumatic upper body injuries were the most frequently occurring condition type for the Low Volume service use category (n=4,271, 31.5%), followed by musculoskeletal upper body (n=4,047, 29.9%). The proportion of claims with a time loss injury appeared to increase as service use volume increased. Time loss injury was highest in the High Volume service use category (n=14,68, 94.3%), and lowest in the Low Volume service use category (n=2,626, 19.4%). In the Medium Volume service use category, there was a similar proportion of those with a time loss claim (n=2,720, 52.8%) and those without (n=2,429, 47.2%).

Table 9 - Number and proportion of claims for each service volume category by demographic, injury and claim factors

	Low Volume N (Col %)	Medium Volume N (Col %)	High Volume N (Col %)
Total	13,551 (66.9)	5,149 (25.4)	1,556 (7.7)
Sex			
Male	13,344 (98.5)	5,034 (97.8)	998 (94.3)
Female	206 (1.5)	114 (2.2)	88 (5.7)
Age group			
<24 years	980 (7.2)	163 (3.2)	45 (2.9)
25-34 years	3,166 (23.4)	916 (17.8)	245 (15.7)
35-44 years	3,507 (25.9)	1,356 (26.3)	418 (26.9)
45-54 years	3,766 (27.8)	1,628 (31.6)	478 (30.7)
55-64 years	2,091 (15.4)	1,064 (20.7)	356 (22.9)
65+ years	41 (0.3)	22 (0.4)	14 (0.9)
Type of condition			
Fractures	684 (5.0)	389 (7.6)	122 (7.8)
MSK upper body	4,047 (29.9)	2,532 (49.2)	803 (51.6)
MSK lower body	1,962 (14.5)	1,193 (23.2)	326 (21.0)
MSK multiple locations	363 (2.7)	239 (4.6)	93 (6.0)
Neurological	535 (3.9)	42 (0.8)	15 (1.0)
Other traumatic lower body	871 (6.4)	127 (2.5)	25 (1.6)
Other traumatic upper body	4,271 (31.5)	477 (9.3)	112 (7.2)
Other traumatic other	478 (3.5)	89 (1.7)	43 (2.8)
Other diseases and other claims	340 (2.5)	61 (1.2)	17 (1.1)
Time loss Injury**			
Yes	2626 (19.4)	2720 (52.8%)	1468 (94.3)
No	10919 (80.6)	2429 (47.2%)	88 (5.7)

*MSK = musculoskeletal, **6 missing

Table 5 reports the findings of multivariate multinomial regression models and shows significant associations, with the Low Volume group being the reference group. Female workers had significantly higher relative risk of being in the High Volume health service use group compared with males (RRR:2.89, 95%CI: 2.10-3.96). Compared with workers who were 45-54 years old, younger workers were significantly less likely to be in the Medium Volume and High Volume health service use groups. However, those older than 65 years had significantly higher chances of being in the High Volume health service use group. In addition, compared with upper body musculoskeletal injuries, other conditions had significantly less risk of being in the Medium Volume and High Volume health service use groups. There was a significant association between whether the claim involved time loss from work. The probability of belonging to the High Volume health service use group increased by nearly 640% among workers with time loss claims compared with medical only claims.

Table 10 – Multivariate logistic regression results showing the relationship between predictors and membership of health service use volume groups

	Medium Volume Group Vs. Low Volume Group			High Volume Group Vs Low Volume Group		
	RRR	**95% CI**	**p-value**	**RRR**	**95% CI**	**p-value**
Sex						
Males	Ref			Ref		
Female	1.27	(0.98-1.63)	0.069	2.89	(2.10-3.96)	<0.001
Age Category						
≤ 24 years	0.45	(0.37-0.54)	<0.001	0.39	(0.28-0.56)	<0.001
25 – 34 years	0.71	(0.64-0.79)	<0.001	0.63	(0.52-0.76)	<0.001
35 – 44 years	0.9	(0.82-0.99)	0.036	0.90	(0.77-1.06)	0.210
45 – 54 years	Ref			Ref		
55 – 64 years	1.1	(0.99-1.22)	0.064	1.16	(0.98-1.38)	0.078
≥65 years and older	1.4	(0.78-2.5)	0.259	2.75	(1.29-5.86)	0.009
Condition Type						
Fractures	0.75	(0.65-0.87)	<0.001	0.59	(0.47-0.74)	<0.001
MSK lower body	0.91	(0.83-1.00)	0.05	0.75	(0.64-0.88)	<0.001
MSK upper body	Ref			Ref		
MSK multiple locations	1.02	(0.85-1.22)	0.843	1.22	(0.92-1.61)	0.165
Neurological	0.13	(0.10-0.18)	<0.001	0.19	(0.11-0.33)	<0.001
Other traumatic lower body	0.25	(0.21-0.31)	<0.001	0.17	(0.11-0.26)	<0.001
Other traumatic upper body	0.21	(0.19-0.23)	<0.001	0.19	(0.15-0.23)	<0.001
Other traumatic other	0.3	(0.24-0.39)	<0.001	0.45	(0.31-0.64)	<0.001
Other diseases and other claims	0.17	(0.13-0.22)	<0.001	0.10	(0.06-0.16)	<0.001
Time loss						
No	Ref			Ref		
Yes	4.29	(3.80-4.61)	<0.001	64.17	(51.44-80.10)	<0.001

Note: The table shows adjusted relative risk ratios (RRR) and 95% confidence intervals (CIs) from multinomial logistic regression model. The Low Volume Group is the reference category. Ref = reference category

RETURN TO WORK PATHWAYS

DESCRIPTIVE STATISTICS

There were 23,257 claims that had aggregated certificate and work status data that were analysed for return to work pathways. Table 11 shows that the majority were male (N=22,701, 97.6%) and had musculoskeletal conditions (N=13,154, 56.6%). Injuries to the upper limbs (N=6,765, 29.1%), lower limbs (N=5,154, 22.2%) and trunk (N=4,724, 20.3%) were most common.

With increasing age, the median time to first return to work also increases, and up to 64 years this pattern is consistent for the last return to work. Similarly, with increasing age a higher proportion were not working at the most recent state, and a higher proportion had no return to work. Females had a delayed first return to work compared to males. Those with traumatic injuries had the shortest median time to first return to work, whereas those with mental health conditions had the highest. Head injuries had the shortest median first and last return to work whereas multiple locations of injury had the longest.

Table 11 - Descriptive statistics by sex, age group, nature of injury and bodily location of injury

	N	col %	First RTW	Last RTW	Last State		No RTW (row %)
			Median (IQR)	Median (IQR)	Ceased (row %)	Resumed (row %)	
Sex*							
F	554	2.4	5.7 (0.7, 33.3)	64.6 (11.5, 250.4)	9.9	90.1	3.2
M	22,701	97.6	2.6 (0.2, 15.1)	28.0 (6.6, 140.7)	5.8	94.2	2.8
Age Group							
15-24 years	1,206	5.2	0.6 (0.0, 4.6)	10.5 (3.5, 35.2)	2.2	97.8	0.8
25-34 years	4,655	20.0	1.3 (0.0, 7.6)	17.3 (5.2, 71.5)	2.8	97.2	1.1
35-44 years	5,762	24.8	2.6 (0.2, 14.2)	28.6 (7.3, 119.5)	4.8	95.2	2.2
45-54 years	6,430	27.6	3.5 (0.3, 19.2)	40.0 (8.9, 192.4)	6.1	93.9	2.8
55-64 years	4,981	21.4	4.6 (0.3, 32.4)	47.5 (7.3, 329.4)	10.5	89.5	5.3
65+ years	223	1.0	10.0 (0.0, 89.9)	30.5 (1.7, 320.3)	13.0	87.0	9.4
Nature of Injury							
Fractures	1,242	5.3	4.9 (0.2, 40.3)	68.1 (30.4, 148.3)	4.0	96.0	1.2
Musculoskeletal	13,154	56.6	3.9 (0.5, 17.4)	46.3 (12.5, 204.2)	7.0	93.0	2.6
Neurological	1,944	8.4	4.0 (0.0, 378.4)	8.7 (0.0, 580.4)	6.9	93.1	6.0
Mental health conditions	281	1.2	64.8 (20.8, 213.2)	116.0 (40.4, 378.5)	33.5	66.5	26.7
Other traumatic	6,201	26.7	0.6 (0.0, 4.6)	8.9 (2.2, 29.9)	2.3	97.7	1.3
Other diseases	397	1.7	5.5 (0.5, 35.6)	75.6 (13.3, 168.9)	7.1	92.9	6.0
Other claims	38	0.2	4.3 (0.0, 19.5)	19.5 (0.3, 83.5)	2.6	97.4	2.6
Bodily Location							
Head	3,275	14.1	0.9 (0.0, 17.1)	3.9 (0.0, 46.7)	4.5	95.5	4.0
Lower Limbs	5,154	22.2	3.4 (0.3, 16.5)	41.3 (10.9, 159.0)	4.9	95.1	1.3
Multiple and Unspecified Locations	2,050	8.8	4.9 (0.4, 42.9)	42.2 (6.0, 340.5)	16.6	83.4	12.0
Neck	1,289	5.5	3.7 (0.5, 16.6)	27.3 (7.2, 159.5)	7.1	92.9	2.7
Trunk	4,724	20.3	3.6 (0.5, 13.6)	32.5 (10.6, 122.6)	6.8	93.2	2.6
Upper Limbs	6,765	29.1	1.6 (0.0, 12.5)	32.2 (8.3, 138.7)	3.3	96.7	0.8

**2 missing, RTW = return to work, Last RTW is the most recently recorded RTW.*

Figure 7 shows that 22.5% of workers had no time off work after their injury. The most common return to work pathway was a (successful) graduated return to work (36.1%) where the worker had a period of full absence followed by partial return to work (modified duties or hours) followed by a return to pre-injury duties, or partial duties after injury before a full return to work, without relapse. Almost three percent only returned to work partially. Around one quarter of workers at one stage (or more) relapsed. Note that those who retired or pursued common law could have had another return to work outcome prior to these outcomes, but were kept separate.

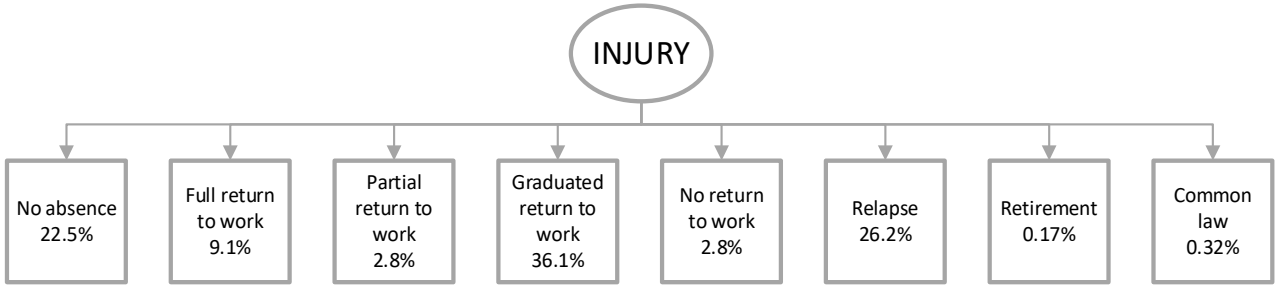

Figure 7 - Proportion of workers following each return to work pathway

Of those that relapsed (N=6,090), 3,966 relapsed once (65.1% of those that relapsed, 17.1% of entire cohort), 1,225 relapsed twice (20.1%, 5.3%) and 899 relapsed more than twice (14.8%, 3.9%).

There were 2,702 workers who at some point during their claim had capacity to work yet there were no suitable/modified duties or hours available. There were 316 workers who relapsed from working (either on suitable/modified or pre-injury duties) to not working yet had capacity to work (5.2% of those that relapsed, 1.4% of entire cohort).

TIME TO FIRST RETURN TO WORK

Table 12 shows similar results between model 1 (excluding health service use predictors) and model 2 (including health service use predictors). Compared to males, females took longer to return to work (for the first time). With increasing age there was also significantly increasing time to first return to work. Neurological and mental health conditions had significantly longer times to first return to work than musculoskeletal conditions, as did fractures and other diseases, whereas other traumatic injuries had shorter times. Earliest first return to work was among those with head injuries and longest for those with multiple or unspecified locations of injury/illness.

Table 12 and Figure 8 show that with increasing volume of health service use there was a statistically significant delay to first return to work.

Table 12 - Cox regression results (days to first return to work)

	Model 1		Model 2	
	HR (95% CI)	**p-value**	**HR (95% CI)**	**p-value**
Sex				
Male	Ref		Ref	
Female	0.84 (0.76, 0.91)	<0.001	0.92 (0.83, 1.02)	0.109
Age Group				
15-24 years	1.51 (1.42, 1.61)	<0.001	1.44 (1.34, 1.54)	<0.001
25-34 years	1.27 (1.22, 1.32)	<0.001	1.28 (1.22, 1.33)	<0.001
35-44 years	1.08 (1.04, 1.12)	<0.001	1.08 (1.04, 1.12)	<0.001
45-54 years	Ref		Ref	
55-64 years	0.92 (0.88, 0.96)	<0.001	0.92 (0.88, 0.96)	<0.001
65+ years	0.82 (0.70, 0.96)	0.012	0.69 (0.54, 0.88)	0.003
Condition Type				
Fractures	0.84 (0.79, 0.89)	<0.001	0.84 (0.79, 0.90)	<0.001
Mental health conditions	0.53 (0.45, 0.62)	<0.001	0.37 (0.29, 0.48)	<0.001
Musculoskeletal	Ref		Ref	
Neurological	0.45 (0.41, 0.49)	<0.001	0.33 (0.29, 0.38)	<0.001
Other claims	1.01 (0.72, 1.42)	0.942	0.83 (0.49, 1.40)	0.483
Other diseases	0.84 (0.76, 0.94)	0.002	0.66 (0.58, 0.75)	<0.001
Other traumatic	1.51 (1.46, 1.56)	<0.001	1.33 (1.28, 1.38)	<0.001
Bodily Location				
Head	1.25 (1.18, 1.32)	<0.001	1.13 (1.06, 1.20)	<0.001
Lower Limbs	0.92 (0.89, 0.95)	<0.001	0.89 (0.85, 0.92)	<0.001
Multiple and Unspecified Locations	0.70 (0.66, 0.74)	<0.001	0.86 (0.81, 0.92)	<0.001
Neck	0.87 (0.81, 0.92)	<0.001	0.88 (0.83, 0.94)	<0.001
Trunk	0.94 (0.91, 0.98)	0.003	0.92 (0.88, 0.96)	<0.001
Upper Limbs	Ref		Ref	
Health Service Use Group				
Low Volume			Ref	
Medium Volume			0.63 (0.61, 0.65)	<0.001
High Volume			0.46 (0.43, 0.48)	<0.001

Note: HR = hazard ratio; CI = confidence interval; Ref = reference category. An HR greater than one indicates earlier return to work.

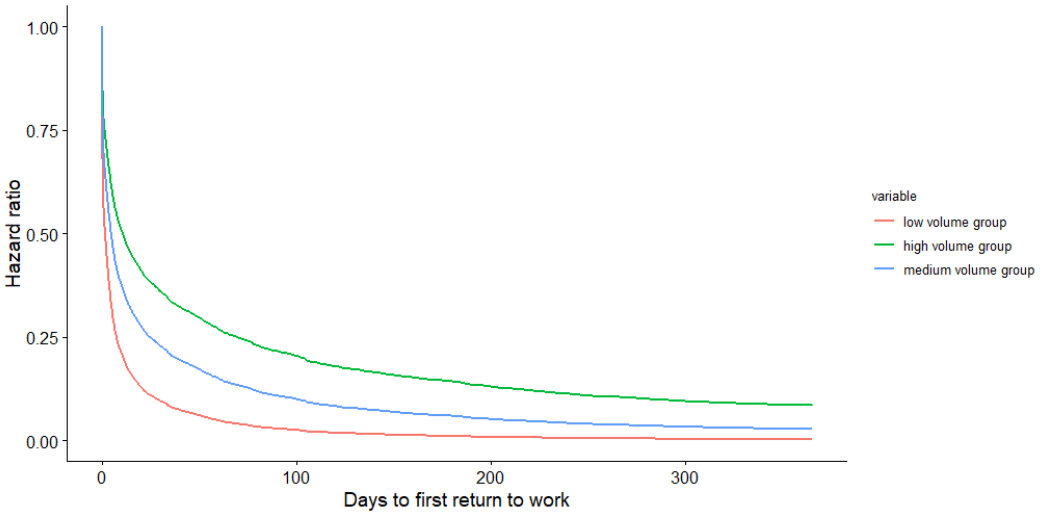

Figure 8 - Adjusted survival curve by health service use group

RELAPSE

Figures 9 and 10 show that females were more likely than males to relapse. There was a generally consistent pattern up to age 65 years that likelihood of relapse increases with age. Those with mental health conditions were less likely to relapse than those with musculoskeletal conditions, and those with other diseases were most likely to relapse. Most likely to relapse were those with conditions affecting the upper and lower limbs. With increasing health service use volume there were increased odds of relapse.

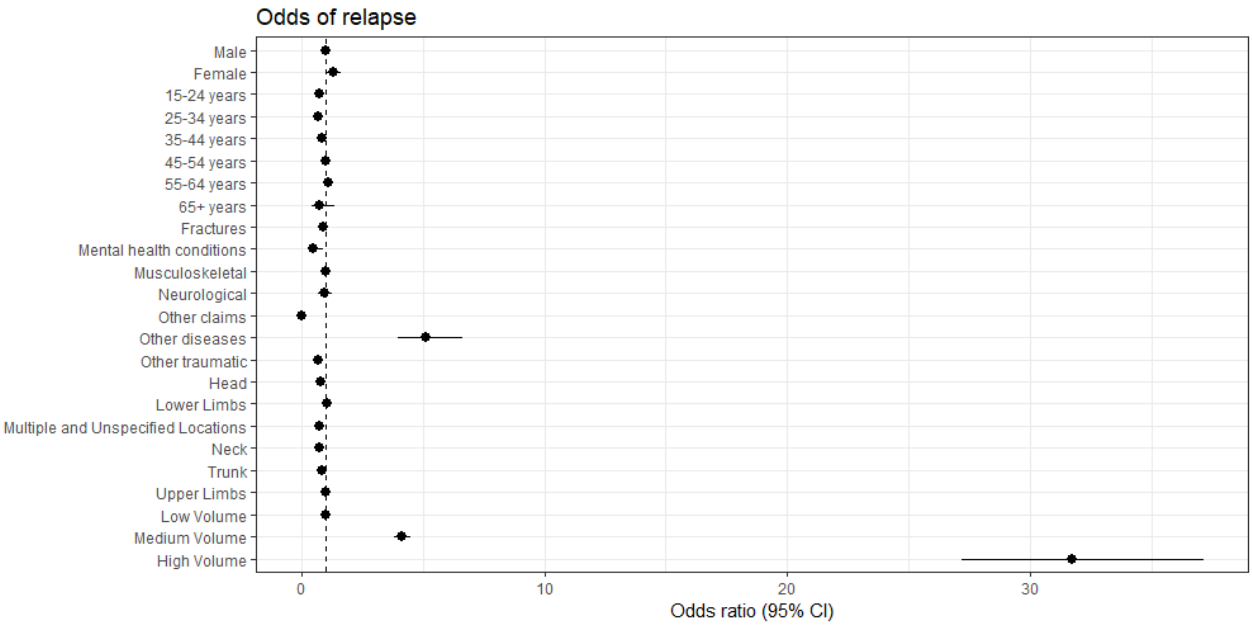

Figure 9 - Forest plot showing odds of relapse by predictor variable

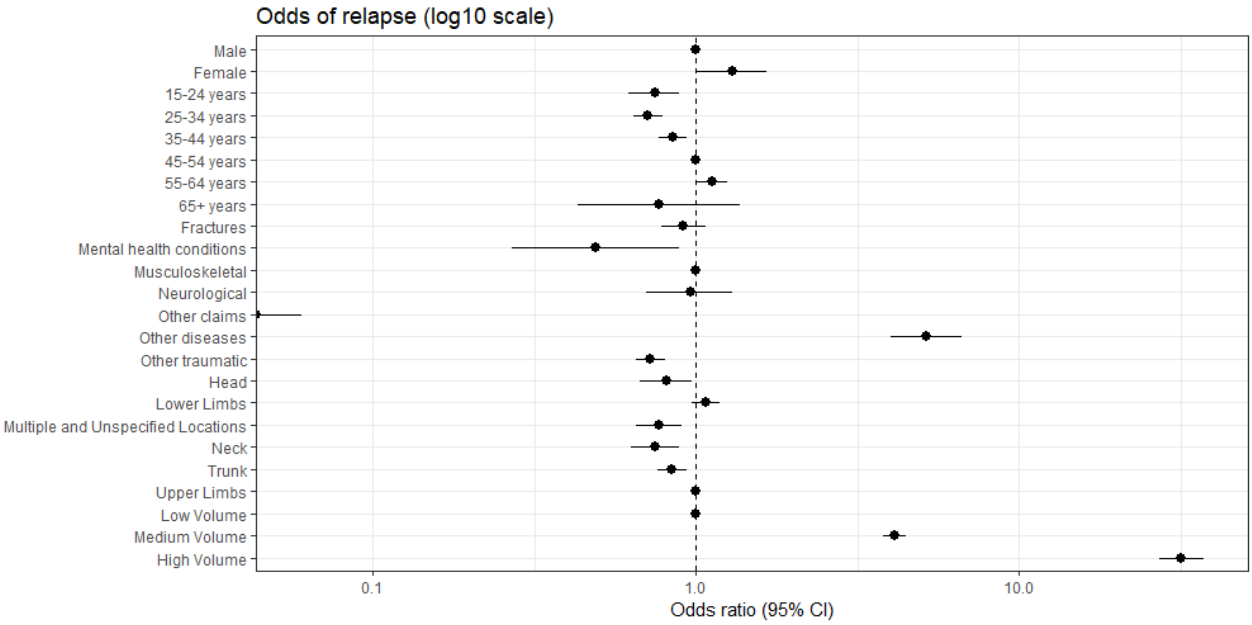

Figure 10 - Forest plot showing odds of relapse by predictor variable (x-axis on log_{10} scale)

SUCCESSFUL GRADUATED RETURN TO WORK

Females were less likely to have a successful graduated return to work (Figure 11). From 15 to 65 years odds of successful graduated return to work decreased with increasing age. Those with fractures were most likely to have a successful graduated return to work, as were those with trunk injuries. Least likely to have a successful graduated return to work were those with high health service use volume.

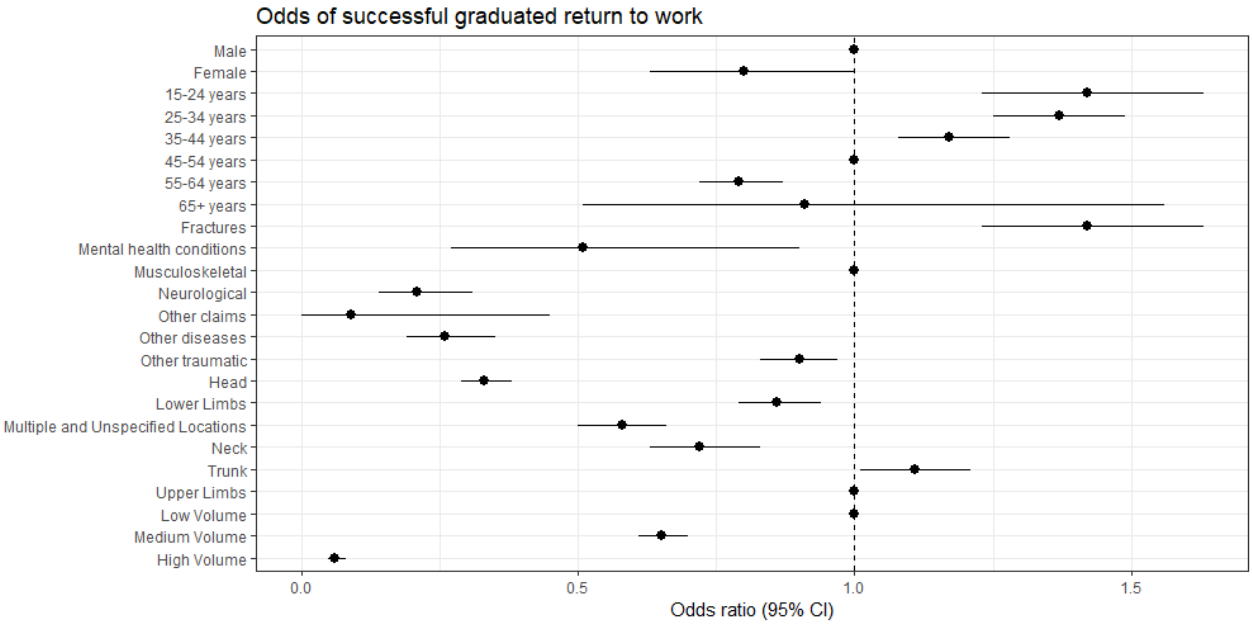

Figure 11 - Forest plot showing odds of successfully returning to work gradually (without relapse) by predictor variable

FULL RETURN TO WORK

Figure 12 shows that females were more likely to have a period of absence followed by full return to work without relapse than males. There were no obvious patterns with age. Workers with mental health conditions and fractures were significantly more likely to have full return to work. Those with upper limb injuries were least likely to have a full return to work. With increasing health service volume there was decreasing odds of full return to work.

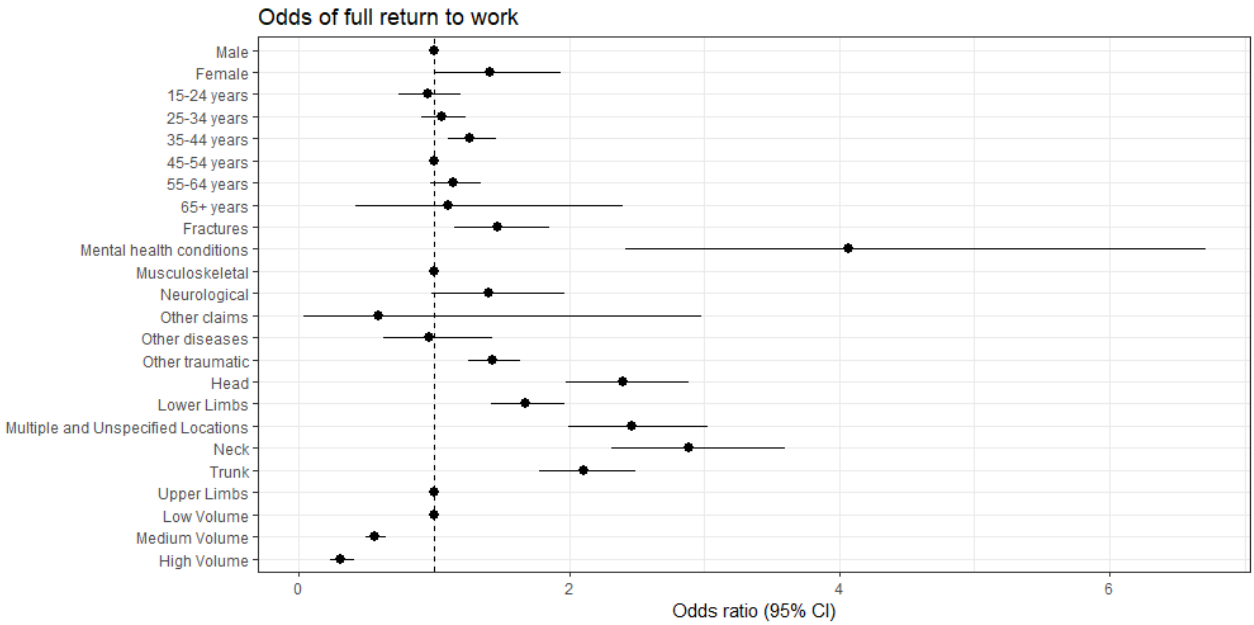

Figure 12 - Forest plot showing odds of full return to work by predictor variable

ANY GRADUATED RETURN TO WORK ATTEMPT

There were no major differences in likelihood of attempting graduated return to work by sex or age, except that those 65+ years were significantly less likely (Figures 13 and 14). Those with fractures or other diseases, or those with injuries to the lower limbs or trunk were significantly more likely to attempt a graduated return to work. Workers utilising a higher volume of health services were more likely to attempt graduated return to work.

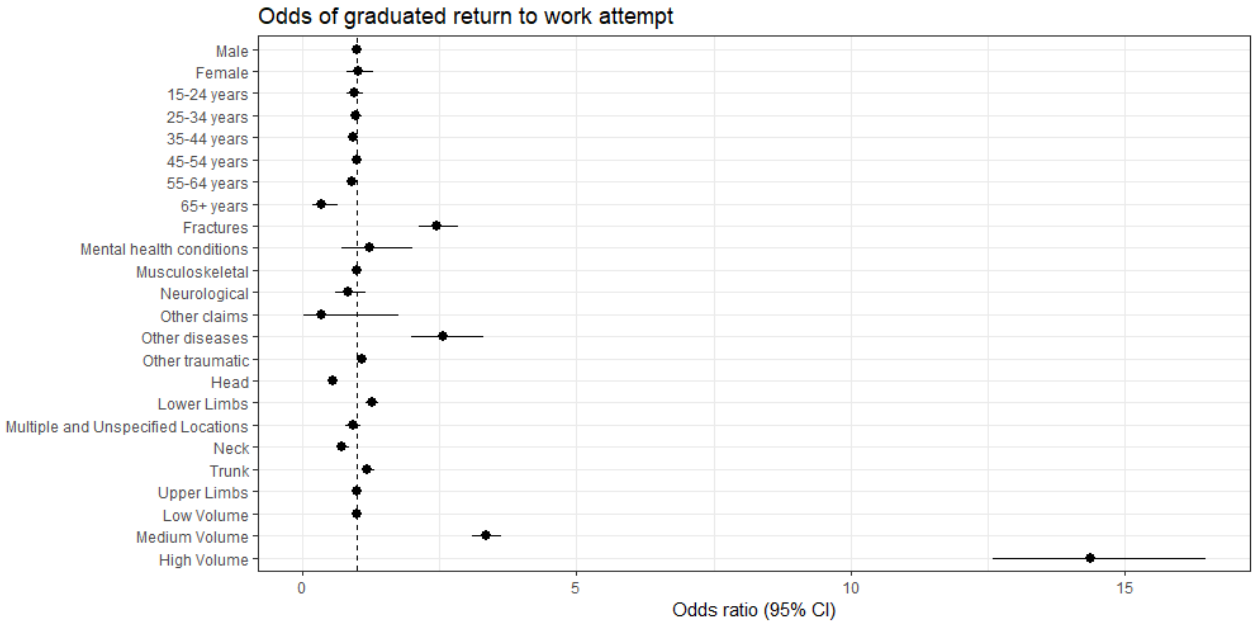

Figure 13 - Forest plot showing odds of attempting a graduated return to work (successful or relapse) by predictor variable

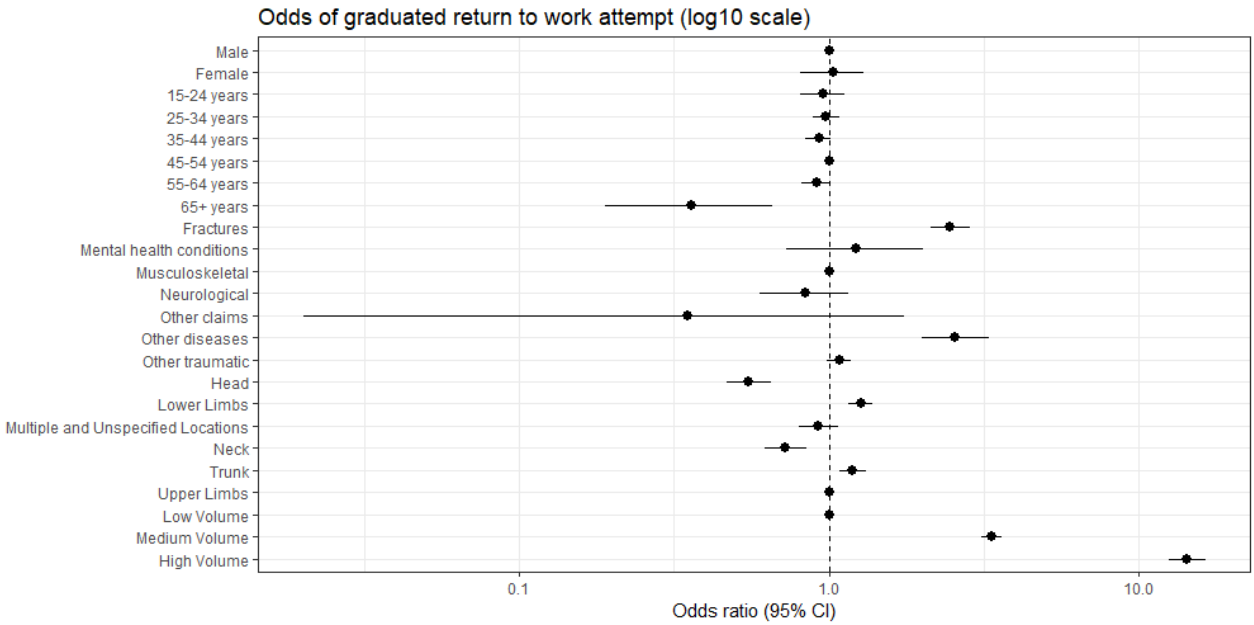

Figure 14 - Forest plot showing odds of attempting a graduated return to work (successful or relapse) by predictor variable (x-axis on log_{10} scale)

NO RETURN TO WORK

Older workers (55+ years) were more likely to have no return to work, as were those with mental health or neurological conditions (Figure 15). Similarly, those with head and multiple injuries were more likely to have no return to work compared to those with upper limb injuries. Those with high health service use volume were more likely than both low and medium volume groups to have no return to work. There were no significant differences by sex.

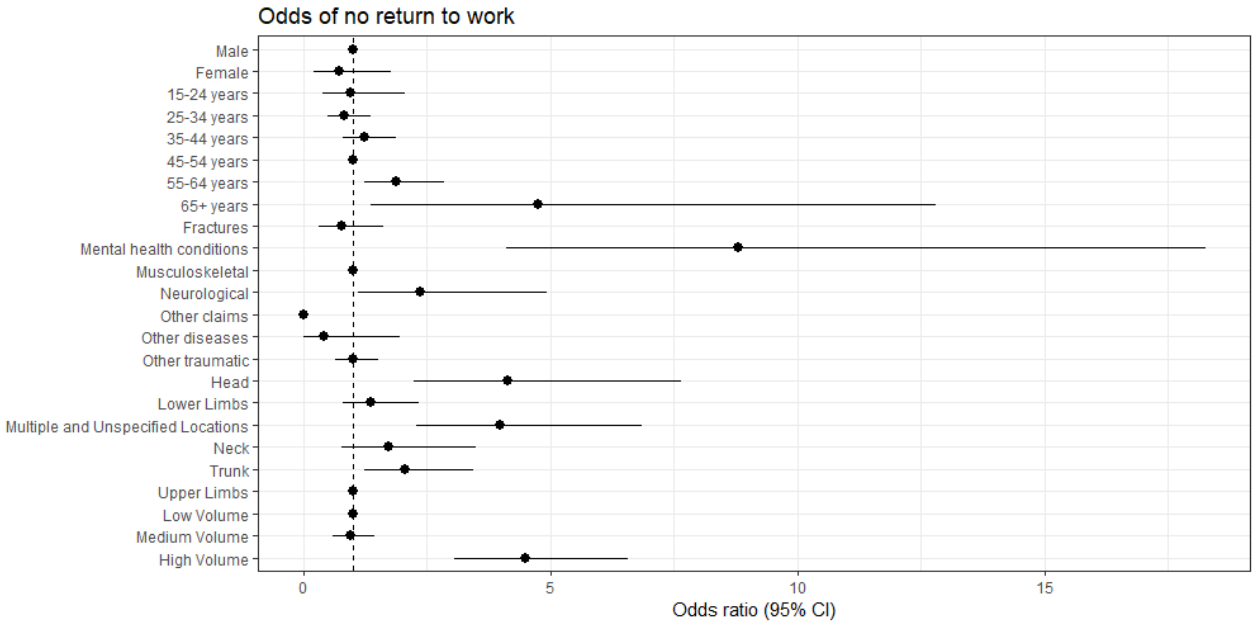

Figure 15 - Forest plot showing odds of no return to work by predictor variable

DISCUSSION

This report presents a new perspective on health service use and return to work among injured/ill workers in the coal mining industry. As a result, it has provided new insights into who is more likely to engage which health services and how often, and the return to work patterns workers will follow during their recovery. More specifically, this report explored the prevalence, timing, duration, volume of service use and factors associated with these (providing valuable information on the health service use patterns of injured workers in the coal mining industry), and the factors associated with following particular return to work pathways (providing insight into who may require more or less support to successfully return to work).

Often referred to as the gatekeepers of the workers' compensation system [6], it was no surprise that GP services were most common and with the highest prevalence. A GP plays a central role in treatment, advice, coordination of complementary treatment and services, rehabilitation and certifying return to work [7]. This finding was also in-line with a previous study investigating health service use which reported that among injured truck-drivers, the service type with the highest proportion of accepted claims was general practitioners [8]. Due to the high prevalence of musculoskeletal conditions in the coal mining cohort, physical therapy services were also highly prevalent. The least prevalent services were psychological services.

Overall, there appeared to be a trend of declining health service use as time passed after injury occurrence, with the largest proportion of service use occurring within the first month of injury. As effective injury management is dependent upon good initial assessment, early treatment and a tailored rehabilitation program, this trend towards early service use should be encouraged [9]. When looking at the timing of the use of specific service types in terms of density, it was unsurprising that ambulance use peaked during the most acute period post injury. This may be linked to the relatively high proportion of hospital use occurring within month one, considering the role of an ambulance service in taking injured people to hospital for emergency care and transporting patients between hospitals. Conversely, the specialist, return to work and psychological services appeared to have a higher density of use as time progressed. The relatively low use of psychological services in the months immediately following injury has been reported in a previous study of health service use among injured workers [8]. In this study the authors suggested this finding could be indicative of a missed opportunity for early intervention in the early stages of mental illness. Physical therapy services were used steadily over the first 12 months and return to work services were mostly used from six months after injury. This relative delay in accessing these services may be related to the acuity and/or complexity of injury.

The timing of health services provided insight into the chronicity of some conditions. For example, traumatic injuries had a high volume of usage very early on then dropped more suddenly than other conditions, indicating that following initial treatment there is less of a need for ongoing health service use. Alternatively, neurological conditions are more likely to require ongoing care. Engaging with specialists, which would be more likely for certain conditions (such as neurological conditions) and require referral from a GP, occurred over a longer duration that other services. This is likely due to conditions that warrant referral to a specialist are more likely to be more severe and/or more chronic than a condition that does not require specialist consultation.

When examining the three derived health service use volume groups, there were no large discrepancies in ambulance or hospital service use, however, there were noticeable increases in predicted counts with increasing volume for physical therapies, GPs, specialists and return to work services. Likely representing the severity of the injuries within each group (e.g. low service use volume a relatively minor injury/illness compared with high service use volume that is a more severe or chronic injury/illness), it is understandable that service use increases. Females were more likely to be in higher volume groups, with increasing age resulting in higher relative risks of being in a higher volume group. Musculoskeletal conditions affecting the upper body or multiple locations as well as time loss claims were significantly more likely to be in a higher volume group. Upper body musculoskeletal claims, particularly those that affect the back, are known to have the potential to be long-term [10].

There was a later first return to work with increasing age and among females. While there were few mental health conditions in the cohort, there was a relatively long time to first return to work and over a quarter had no return to work. Traumatic injuries had the fastest return to work while neurological conditions had the slowest. Head injuries had the shortest time to first return to work and injuries to multiple bodily locations had the longest, however when service use volume was factored into the regression model these evened out somewhat. With increasing health service use volume there was slower first return to work, likely representing severity of condition. However, only those with high service use volume had greater odds of no return to work at all. There is evidence that both subjective and objective measures of injury severity predict return to work outcomes [11, 12]. A patient's appraisal of their injury severity has been significantly associated with return to work, as has the derived injury severity score, based on a person's injury type(s) and bodily locations affected.

There was a high proportion of workers who followed a successful graduated return to work pathway in that they had a period of full absence followed by a period of modified duties and/or hours followed by a full return to work (or modified duties after injury prior to return to pre-injury duties). Furthermore, there were also additional workers who attempted a graduated return to work yet at some point relapsed. This differs from a cohort injured in a road traffic crash who were insured by a compulsory third party scheme which found only 9.6% followed a successful graduated return to work pathway [13]. This is also much higher than a cohort of mixed compulsory third party and workers' compensation claimants injured in a road traffic crash (7.2%) [14]. This is suggestive of employers in the coal mining industry who are both willing and able to provide suitable or modified duties, or allow part-time returns to the workplace to enable some return to work to aid recovery.

Those with fractures and trunk injuries were both more likely to attempt graduated return to work and have a successful return to work, whereas those in medium or high service use categories were more likely to attempt it but less likely to have a successful return to work and therefore relapse. It is possible that a worker with a more severe injury (who is more likely to use a greater number of health services) is either returning to (any) work before being ready, or increasing their duties and/or fraction too soon which is resulting in the relapse and would be worthy of some focus.

There were conflicting results with regard to mental health conditions. There was a long time to first return to work and higher odds of no return to work, yet higher odds of full return to work and lower odds of relapse. Results suggest the possibility of those with mental health conditions either remaining off work until they, their employer and treating doctor feel they will have a sustained return to work rather than "testing the waters", or not returning to work at all. In saying that, the longest duration until first return to work is consistent with other cohorts of workers with mental health conditions [15]. There were, however, considerably fewer mental health conditions than physical conditions in the cohort and therefore fewer cases for analysis.

There were consistent patterns regarding age throughout both health service use and return to work analyses. In general, with increasing age there was increased health service use and slower return to work with higher odds of relapse. Physiologically, older workers take longer for tissue repair and have less smooth muscle elasticity [16]. Furthermore, older workers are more likely to have comorbidities that can complicate recovery, affecting both healing of injury/illness and ability to return to work. This pattern of delayed return to work and higher likelihood of relapse is commonly seen across injured cohorts [14, 16-18].

STRENGTHS AND LIMITATIONS

Data presented in this report utilised rich and informative datasets of claims to Coal Mines Insurance, which is the specialised workers' compensation scheme for the New South Wales coal mining industry. The longitudinal nature of the compensation payment data provided the opportunity to track detailed service level information (on a per payment basis) of injured/ill workers. The data allows examination of the type, intensity and duration of health service use across multiple health providers and service types over time. Furthermore, the aggregated work status and certificate dataset allowed detailed investigation of return to work patterns that were followed after injury/illness. To our knowledge, this is the first time health service use and return to work patterns have been described in a coal mining industry cohort.

However, data are administrative and not collected for the purposes of research, rather it is used by Coal Mines Insurance to provide a compensation service to injured or ill workers. Therefore, it could be subject to data quality issues such as completeness, accuracy and other limitations as it relies on a variety of people external to the research group to input information. The research team has made every effort to best overcome any of these issues to ensure consistent and correct data. Furthermore, it is also possible that not all episodes of health service use are captured in the data as payments may be covered by Medicare or other means rather than workers' compensation in some instances. The payment data for some health service use were possibly aggregated, which may have affected the ability to capture the exact timing of an individual episode of health service use. Aggregated work status and certificate data also has the potential to omit changes in work status, affecting the return to work analysis. Finally, variables that might influence the duration of health service use or return to work, such as injury severity, co-morbid health conditions or individual circumstances such as social support, are absent from the database and cannot be incorporated into the analysis. All results must be interpreted bearing in mind the limitations.

SUMMARY AND CONCLUSION

Understanding health service use and return to work in injured/ill workers is important for the planning and management of health and insurance system resources to support worker recovery and return to work, and also for targeting services to those with the most need. This report provides insight into the type, prevalence, timing and duration of health service use, providing valuable information on the recovery process and identifying factors associated with different patterns of care. Additionally, findings also provided insight into the factors associated with following a variety of return to work pathways and therefore highlights those workers that may benefit from targeted support.

This study suggests that about a third of injured coal mining workers may have persistent health service needs that could extend for at least 3 years post work-related injury or illness (medium or high volume of use). This is especially true for older workers and those with musculoskeletal upper body injuries. Results also demonstrate that the timing of health services varied by service and condition type. Findings of relatively longer return to work service duration is noteworthy, potentially reflecting challenges faced by this cohort

in regards to effective injury recovery. There were relatively consistent findings that older workers have poorer return to work outcomes, as do those with medium-high volume health service use.

Due to the age-related findings across health service and return to work analysis, there are possible benefits to investment in improving physical and psychological health and wellbeing of younger workers to both reduce incidence of injury/illness but also promote faster and more effective recovery in the event of injury/illness. This warrants further attention. This report adds to the existing literature regarding patterns of health service use in specific cohorts of injured workers, and has the potential to inform decision making for service planning and cost prediction, and also to ensure appropriate service provision for injured coal miners.

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APPENDIX

Table 13A - Full logistic regression results (excluding health service use factors)

	Full return to work				Successful graduated return to work				Relapse			
	N	% of cohort	row %	Odds ratio (95% CI)	N	% of cohort	row %	Odds ratio (95% CI)	N	% of cohort	row %	Odds ratio (95% CI)
Sex												
Female	80	0.3	14.4	1.49 (1.16, 1.91)*	175	0.8	31.6	0.69 (0.57, 0.83)*	201	0.9	36.3	1.67 (1.39, 2.00)*
Male	2034	8.7	9.0	Ref	8227	35.4	36.2	Ref	5889	25.3	25.9	Ref
Age Group												
15-24 years	113	0.5	9.4	1.05 (0.84, 1.30)	571	2.5	47.3	1.58 (1.38, 1.79)*	237	1.0	19.7	0.61 (0.52, 0.71)*
25-34 years	440	1.9	9.5	1.10 (0.96, 1.26)	2125	9.1	45.6	1.48 (1.37, 1.60)*	1019	4.4	21.9	0.66 (0.60, 0.72)*
35-44 years	600	2.6	10.4	1.25 (1.10, 1.41)*	2322	10.0	40.3	1.22 (1.13, 1.32)*	1548	6.7	26.9	0.85 (0.79, 0.93)*
45-54 years	526	2.3	8.2	Ref	2191	9.4	34.1	Ref	1889	8.1	29.4	Ref
55-64 years	426	1.8	8.6	1.11 (0.96, 1.27)	1169	5.0	23.5	0.73 (0.66, 0.79)*	1363	5.9	27.4	1.04 (0.95, 1.13)
65+ years	9	0.0	4.0	0.54 (0.25, 1.00)	24	0.1	10.8	0.51 (0.31, 0.79)*	34	0.1	15.2	0.78 (0.52, 1.14)
Condition Type												
Fractures	115	0.5	9.3	1.37 (1.11, 1.69)*	587	2.5	47.3	1.39 (1.23, 1.57)*	395	1.7	31.8	1.03 (0.90, 1.17)
Mental health conditions	91	0.4	32.4	3.50 (2.61, 4.67)*	38	0.2	13.5	0.49 (0.34, 0.70)*	48	0.2	17.1	0.55 (0.39, 0.76)*
Musculoskeletal	1058	4.5	8.0	Ref	5156	22.2	39.2	Ref	4316	18.6	32.8	Ref
Neurological	110	0.5	5.7	0.51 (0.39, 0.67)*	35	0.2	1.8	0.08 (0.06, 0.12)*	123	0.5	6.3	0.26 (0.21, 0.34)*
Other claims	5	0.0	13.2	1.29 (0.44, 3.07)	6	0.0	15.8	0.44 (0.16, 1.00)	5	0.0	13.2	0.41 (0.14, 0.98)
Other diseases	39	0.2	9.8	1.17 (0.82, 1.62)	74	0.3	18.6	0.34 (0.26, 0.44)*	166	0.7	41.8	1.61 (1.30, 1.97)*
Other traumatic	696	3.0	11.2	1.50 (1.33, 1.69)*	2506	10.8	40.4	1.17 (1.09, 1.26)*	1037	4.5	16.7	0.48 (0.44, 0.52)*
Bodily Location												
Head	337	1.4	10.3	2.41 (2.02, 2.87)*	389	1.7	11.9	0.35 (0.31, 0.40)*	250	1.1	7.6	0.39 (0.32, 0.46)*
Lower Limbs	434	1.9	8.4	1.56 (1.35, 1.81)*	2054	8.8	39.9	0.91 (0.84, 0.98)*	1676	7.2	32.5	0.98 (0.90, 1.07)
Multiple and Unspecified Locations	325	1.4	15.9	2.46 (2.07, 2.93)*	460	2.0	22.4	0.45 (0.40, 0.51)*	451	1.9	22.0	0.64 (0.56, 0.72)*
Neck	164	0.7	12.7	2.53 (2.07, 3.07)*	444	1.9	34.4	0.73 (0.64, 0.82)*	358	1.5	27.8	0.77 (0.67, 0.88)*
Trunk	438	1.9	9.3	1.81 (1.56, 2.10)*	2068	8.9	43.8	1.13 (1.04, 1.22)*	1415	6.1	30.0	0.81 (0.74, 0.88)*
Upper Limbs	416	1.8	6.2	Ref	2987	12.8	44.2	Ref	1940	8.3	28.7	Ref

	Attempted graduated return to work				No return to work			
	N	% of cohort	row %	Odds ratio (95% CI)	N	% of cohort	row %	Odds ratio (95% CI)
Sex								
Female	221	1.0	39.9	1.54 (1.29, 1.84)*	18	0.1	3.2	0.87 (0.50, 1.42)
Male	6593	28.4	29.0	Ref	636	2.7	2.8	Ref
Age Group								
15-24 years	329	1.4	27.3	0.78 (0.68, 0.90)*	10	0.0	0.8	0.40 (0.19, 0.72)*
25-34 years	1388	6.0	29.8	0.87 (0.80, 0.95)*	53	0.2	1.1	0.46 (0.34, 0.63)*
35-44 years	1775	7.6	30.8	0.92 (0.85, 0.99)*	127	0.5	2.2	0.83 (0.66, 1.06)
45-54 years	2013	8.7	31.3	Ref	177	0.8	2.8	Ref
55-64 years	1285	5.5	25.8	0.90 (0.82, 0.98)*	266	1.1	5.3	1.67 (1.36, 2.05)*
65+ years	24	0.1	10.8	0.50 (0.31, 0.77)*	21	0.1	9.4	2.41 (1.43, 3.87)*
Condition Type								
Fractures	631	2.7	50.8	2.33 (2.06, 2.64)*	15	0.1	1.2	0.86 (0.48, 1.42)
Mental health conditions	78	0.3	27.8	0.99 (0.74, 1.31)	75	0.3	26.7	3.54 (2.55, 4.89)*
Musculoskeletal	4454	19.2	33.9	Ref	342	1.5	2.6	Ref
Neurological	73	0.3	3.8	0.22 (0.17, 0.29)*	117	0.5	6.0	1.79 (1.10, 2.94)*
Other claims	5	0.0	13.2	0.40 (0.14, 0.94)	1	0.0	2.6	0.40 (0.02, 1.91)
Other diseases	146	0.6	36.8	1.16 (0.94, 1.43)	24	0.1	6.0	1.92 (1.20, 2.93)*
Other traumatic	1427	6.1	23.0	0.73 (0.67, 0.78)*	80	0.3	1.3	0.59 (0.45, 0.77)*
Bodily Location								
Head	240	1.0	7.3	0.33 (0.28, 0.38)*	132	0.6	4.0	2.48 (1.50, 4.05)*
Lower Limbs	1876	8.1	36.4	1.15 (1.06, 1.25)*	65	0.3	1.3	1.34 (0.93, 1.95)
Multiple and Unspecified Locations	523	2.2	25.5	0.74 (0.66, 0.84)*	245	1.1	12.0	10.90 (7.98, 15.11)*
Neck	342	1.5	26.5	0.75 (0.65, 0.86)*	35	0.2	2.7	3.00 (1.92, 4.62)*
Trunk	1660	7.1	35.1	1.09 (1.00, 1.18)	123	0.5	2.6	2.68 (1.93, 3.78)*
Upper Limbs	2173	9.3	32.1	Ref	54	0.2	0.8	Ref

* Denotes statistical significance at p<0.05 level. Ref = reference category; CI = confidence interval.

Table 14A - Full regression results (including health service use factors)

	Full return to work				Successful graduated return to work				Relapse			
	N	% of cohort	row %	Odds ratio (95% CI)	N	% of cohort	row %	Odds ratio (95% CI)	N	% of cohort	row %	Odds ratio (95% CI)
Sex												
Female	45	0.2	11.4	1.41 (1.01, 1.94)*	129	0.7	32.7	0.80 (0.63, 1.00)	164	0.9	41.5	1.30 (1.01, 1.66)*
Male	1571	8.7	8.9	Ref	7163	39.8	40.6	Ref	5194	28.8	29.5	Ref
Age Group												
15-24 years	95	0.5	8.8	0.95 (0.74, 1.20)	527	2.9	48.8	1.42 (1.23, 1.63)*	213	1.2	19.7	0.75 (0.62, 0.89)*
25-34 years	357	2	9.1	1.06 (0.91, 1.23)	1850	10.3	47	1.37 (1.25, 1.49)*	899	5	22.9	0.71 (0.64, 0.79)*
35-44 years	477	2.6	10.1	1.26 (1.10, 1.46)	1986	11	42	1.17 (1.08, 1.28)*	1369	7.6	28.9	0.85 (0.77, 0.94)*
45-54 years	403	2.2	8	Ref	1927	10.7	38.1	Ref	1675	9.3	33.1	Ref
55-64 years	278	1.5	8.8	1.14 (0.97, 1.35)	982	5.4	31.2	0.79 (0.72, 0.87)*	1176	6.5	37.4	1.12 (1.01, 1.25)*
65+ years	6	0	8.5	1.10 (0.42, 2.40)	20	0.1	28.2	0.91 (0.51, 1.56)	26	0.1	36.6	0.77 (0.43, 1.37)
Condition Type												
Fractures	93	0.5	8.7	1.47 (1.15, 1.85)	510	2.8	47.9	1.42 (1.23, 1.63)*	359	2	33.7	0.91 (0.78, 1.07)
Musculoskeletal	800	4.4	7.5	Ref	4412	24.5	41.2	Ref	3785	21	35.3	Ref
Neurological	52	0.3	14.1	1.40 (0.98, 1.97)	28	0.2	7.6	0.21 (0.14, 0.31)*	82	0.5	22.2	0.96 (0.70, 1.29)
Mental health conditions	26	0.1	30.2	4.07 (2.42, 6.71)*	15	0.1	17.4	0.51 (0.27, 0.90)*	22	0.1	25.6	0.49 (0.27, 0.89)*
Other traumatic	618	3.4	11.2	1.43 (1.25, 1.64)*	2271	12.6	41.3	0.90 (0.83, 0.97)*	964	5.3	17.5	0.72 (0.65, 0.80)*
Other diseases	26	0.1	9.6	0.96 (0.62, 1.43)	55	0.3	20.3	0.26 (0.19, 0.35)*	146	0.8	53.9	5.15 (4.00, 6.65)*
Other claims	1	0	6.7	0.59 (0.03, 2.98)	1	0	6.7	0.09 (0.00, 0.45)*	0	0	0	0.00 (0.00, 0.06)
Bodily Location												
Head	256	1.4	16.4	2.40 (1.98, 2.89)*	353	2	22.6	0.33 (0.29, 0.38)*	212	1.2	13.6	0.81 (0.67, 0.97)*
Lower Limbs	353	2	8.1	1.68 (1.42, 1.97)*	1777	9.9	40.6	0.86 (0.79, 0.94)*	1502	8.3	34.3	1.07 (0.97, 1.18)
Multiple and Unspecified Locations	169	0.9	13.3	2.46 (1.99, 3.03)*	368	2	28.9	0.58 (0.50, 0.66)*	370	2.1	29.1	0.77 (0.65, 0.90)*
Neck	137	0.8	12.5	2.89 (2.31, 3.60)*	392	2.2	35.9	0.72 (0.63, 0.83)*	325	1.8	29.7	0.75 (0.63, 0.89)*
Trunk	371	2.1	9.4	2.11 (1.78, 2.49)*	1792	9.9	45.4	1.11 (1.01, 1.21)*	1252	6.9	31.8	0.84 (0.76, 0.94)*
Upper Limbs	330	1.8	5.7	Ref	2610	14.5	45.2	Ref	1697	9.4	29.4	Ref
Health Service Use Group												
Low	1263	7	11	Ref	5254	29.2	45.8	Ref	1771	9.8	15.4	Ref
Medium	297	1.6	5.9	0.56 (0.49, 0.64)*	1947	10.8	38.9	0.65 (0.61, 0.70)*	2251	12.5	45	4.13 (3.81, 4.48)*
High	56	0.3	3.6	0.31 (0.23, 0.41)*	91	0.5	5.8	0.06 (0.05, 0.08)*	1336	7.4	85.9	31.69 (27.19, 37.10)*

	Attempted graduated return to work				No return to work			
	N	% of cohort	row %	Odds ratio (95% CI)	N	% of cohort	row %	Odds ratio (95% CI)
Sex								
Female	162	0.9	41	1.03 (0.81, 1.30)	4	0.0	1.0	0.72 (0.22, 1.77)
Male	5806	32.2	32.9	Ref	175	1.0	1.0	Ref
Age Group								
15-24 years	296	1.6	27.4	0.96 (0.81, 1.12)	7	0.0	0.6	0.97 (0.39, 2.05)
25-34 years	1220	6.8	31	0.98 (0.89, 1.08)	25	0.1	0.6	0.82 (0.49, 1.36)
35-44 years	1549	8.6	32.7	0.93 (0.84, 1.01)	47	0.3	1.0	1.23 (0.80, 1.88)
45-54 years	1783	9.9	35.2	Ref	42	0.2	0.8	Ref
55-64 years	1103	6.1	35.1	0.91 (0.82, 1.01)	54	0.3	1.7	1.88 (1.24, 2.86)*
65+ years	17	0.1	23.9	0.36 (0.19, 0.66)*	4	0.0	5.6	4.76 (1.36, 12.81)*
Condition Type								
Fractures	561	3.1	52.7	2.46 (2.13, 2.85)*	7	0	0.7	0.79 (0.32, 1.63)
Musculoskeletal	3878	21.5	36.2	Ref	96	0.5	0.9	Ref
Neurological	58	0.3	15.7	0.84 (0.60, 1.16)	15	0.1	4.1	2.37 (1.10, 4.92)*
Mental health conditions	34	0.2	39.5	1.22 (0.73, 2.02)	14	0.1	16.3	8.79 (4.11, 18.25)*
Other traumatic	1317	7.3	23.9	1.08 (0.99, 1.18)	46	0.3	0.8	1.00 (0.64, 1.53)
Other diseases	119	0.7	43.9	2.56 (1.99, 3.30)*	1	0.0	0.4	0.43 (0.02, 1.96)
Other claims	1	0.0	6.7	0.35 (0.02, 1.75)	0	0.0	0.0	0.00 (0.00, 0.00)
Bodily Location								
Head	219	1.2	14	0.55 (0.47, 0.65)*	32	0.2	2.1	4.14 (2.24, 7.64)*
Lower Limbs	1669	9.3	38.1	1.27 (1.16, 1.39)*	30	0.2	0.7	1.38 (0.81, 2.34)
Multiple and Unspecified Locations	418	2.3	32.8	0.92 (0.80, 1.07)	40	0.2	3.1	3.97 (2.29, 6.86)*
Neck	305	1.7	27.9	0.72 (0.62, 0.85)*	10	0.1	0.9	1.73 (0.79, 3.50)
Trunk	1456	8.1	36.9	1.19 (1.08, 1.32)*	39	0.2	1.0	2.06 (1.24, 3.44)*
Upper Limbs	1901	10.5	33	Ref	28	0.2	0.5	Ref
Health Service Use Group								
Low	2360	13.1	20.6	Ref	93	0.5	0.8	Ref
Medium	2384	13.2	47.7	3.36 (3.11, 3.63)*	33	0.2	0.7	0.95 (0.61, 1.44)
High	1224	6.8	78.7	14.37 (12.58, 16.46)*	53	0.3	3.4	4.50 (3.06, 6.57)*

*denotes statistical significance at p<0.05 level. Ref = reference category; CI = confidence interval.

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