

# Length of Stay in Hospital Following Occupational Injury

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## Abstract

**Background:** Length of stay in hospital (LOS) is regarded as a useful indicator of morbidity and an important determinant of medical care cost. LOS has been shown to have implications for post injury functionality, return to work, sickness absence and some psychosocial health outcomes such as quality of life. However, not much is known about LOS following occupational injury. The present study examined LOS and its predictors in a population of Swedish workers injured at work, and admitted for hospital care between 2007 and 2012.

**Methods:** The study is based on data from the Swedish Working Environment Agency and hospital records of injured workers in the county of Gävleborg, Sweden. Specifically those admitted and discharged alive during the period under review.

**Results:** A total of 1608 cases were identified, 34.4% were from the manufacturing sector, 32.2% had injuries of the upper extremities, mean LOS was 2.78 days. Individual level independent predictors of LOS were employment and injury location. Factors such as referrals, admitting ward and diagnose related groups (DGRs) were hospital level predictors of LOS. Injured workers admitted to the orthopedic ward and those referred from other clinics had approximately four fold likelihood of LOS greater than 3 days.

**Discussion:** The findings show individual and hospital level factors were identified as predictors of LOS in hospital following an occupational injury. The likely implications of these findings are discussed.

**Keywords:** Diagnose related group; Hospital admission; Length of stay; Occupational injury; Workers

## Introduction

Length of stay in hospital (LOS), following an injury has been shown to play significant role in predicting post injury health and functional outcomes such as quality of life [1] and disability [2-4]. For injured workers, LOS is critical for return to work [5] and is regarded as a likely useful indicator of morbidity and a determinant of the cost of medical care [6]. The economic cost of trauma care is one of the most expensive forms of medical care [5,7,8] thus healthcare systems in different countries adopt different measures to curb costs.

In Sweden specifically, the years from 2001 to 2010 witnessed as much as 10% reduction in the total number of available hospital bed spaces, with consequent reduction in LOS [9-11]. Another cost saving method is the adoption of different tools for economic efficiency such as the use of Diagnosis Related Groups (DRG) based financing system. DRG is a means of describing hospital case mix i.e. types of cases seen and how long they are treated. It is used in order to determine diagnoses which demand more resources. Not much however, is known about how these measures and other factors affect LOS.

Other known factors which have implication for LOS include patient age, injury severity, medical state at the time of admission, onset of treatment or surgery initiation [5,12,13]. So far, available studies on LOS are mostly on medical conditions [14], general injuries [15,16] or a combination of both. Not much is known about LOS due to occupational injuries in Sweden. We hypothesize that factors influencing LOS due to occupational injuries may be similar to known factors associated with LOS due to injuries in general but also to factors related to work. The aim of this paper therefore is to examine LOS following occupational injury and its determinants.

## Materials and Methods

### Setting and participants

The present study is based on two linked register data. One is from a register kept by the Swedish National Working Environment Agency covering all cases of occupational

injuries reported to the Swedish social security board. The register includes details on age, injury cause, occupational sector etc. and was linked to hospital records of occupational injury patients admitted between 2007 and 2012 and discharged alive. Clinical records of patients from admission to discharge, including information on referring and admitting clinic, DRG among others were extracted on an aggregate level. A total of 1608 cases of injured male and female workers were identified.

## Measures

**Dependent variables:** Length of Hospital Stay (LOS). This describes the total number of days spent in the hospital for in-patient care dichotomized into less than three days and three days or more.

**Independent variables:** *Demographic factors* include sex, age, marital status, employment status and country background (i.e. foreign born workers versus workers born in Sweden).

**Injury cause:** Injury type and mechanism were coded according to the International Classification of Diseases, 10<sup>th</sup> revision (ICD-10) and were grouped as follows:

Falls; Loss of control of machines/tools; Electrical problems/explosion/fire; leakage/outflow/overflow of fluid, gas, particles etc; collapsing of objects and structures; body movement without any physical stress (defined as injuries sustained due to stepping on sharp objects, running, walking, running into or being hit against something); and lastly body movement under or with physical stress (defined as injuries due to lifting, carrying load and other physically strenuous movements including slips).

**Injury location on the body:** Injury location describes the specific part of the body on which injury occurred categorized into head and neck; trunk, upper extremities; lower Extremities and Others such as injuries involving multiple locations on the body.

**Occupational sector:** This is the industrial sector to which the injured workers belonged using the 2007 version of the Swedish Standard Industrial Classification (SNI) [17]. The SNI is based on the European Union's standard for classification of economic sectors (Statistics Sweden). The following six categories were used in this study: manufacturing, construction, education, transport and Healthcare (including social assistance services such as care home staff etc.). All other sectors were classified as "others" due to relatively few cases.

**Hospital regions:** A healthcare region consists of a major teaching hospital and a group of surrounding municipalities who collaborate for the effective utilization and management of healthcare resources within the region. There are currently six regions in Sweden and they are politically and democratically governed.

**Year of injury:** In other to study if there any impact of changes in healthcare practice over time, year of injury was also taken into consideration. Two categories are defined *viz*: 2007 till 2009 and 2010 till 2012.

**DRG:** Sweden uses the Nordic DRG, NordDRG which provides a common language for economist, health planers and medical staff in describing medical needs and available resources (Swedish National board of health and welfare, 2010). NordDRG is divided into 29 chapters known as the Major Diagnostic Categories (MDC). The appropriate DRG is determined by the main diagnoses. To enable statistical power, four main categories were used for this study, *viz* Nervous system; Eyes/ENT/Respiratory/Dermatology; Musculoskeletal and Others.

**Visit by scheduled appointment:** Dichotomized as yes or no.

**Mode of arrival/admission:** Described as whether patient came in from e.g. home/workplace, other living arrangement or referred from another hospital. In this study, the variable is dichotomized into "arrived from workplace/home or referred by other hospital or clinic.

**Admission destination:** The clinic department to which the patient was admitted on arrival and consisting of three groups namely orthopedics, other surgery and medicine.

**Discharge destination:** All identified cases for this study were either discharge home or referred to other hospital/clinic.

**Statistics:** Descriptive statistics were run to understand the distribution of participants by demographic and occupational characteristics. Where necessary, the dependent and independent variables were transformed to reduce categories in order to increase statistical power and enhance meaningful statistical interpretation. However all transformations remain logical. The association between the dependent variables (i.e. LOS) and independent variables were assessed using chi-square test. Only statistically significant variables from these analyses qualified for logistic regression. The magnitude and directions of associations were expressed as adjusted odds ratios in the logistic regressions. Statistical significance value of  $p < 0.05$  was assumed for the logistic regressions. All data were analyzed in IBM SPSS version 21.

## Ethical Consideration

Ethical approval for the study was granted the regional institutional review board with office at the University of Uppsala, Sweden. Approval Reference: Dnr: 2014/084.

## Results

A total of 1608 injury cases were admitted to the hospital. Mean LOS for this sample was about 2.78 days. As shown in table 1, the majority of patients admitted to the hospital following occupational injuries were male, of Swedish background, married or cohabiting, employed within the manufacturing sector and fulltime employed. Most injuries occurred in the upper and lower extremities and were caused by loss of control and falls, were admitted straight in to orthopedics units and mostly fell within the musculoskeletal DRGs.

Table 2 shows age and gender were associated with LOS  $\chi^2(1)=8.2$ ;  $p=0.004$ , with male patients more prone to sick-leave

**Table 1:** Demographic: Injury and hospital level characteristics of occupational injuries admitted to hospitals between 2007-2012.

Variables	n	%
<b>Sociodemographic factors</b>		
<b>Age groups</b>		
30 and below	375	23.3
31-40	302	18.8
41-50	378	23.5
51-60	413	25.7
61plus	140	8.7
<b>Gender</b>		
Female	471	29.3
Male	1137	70.3
<b>Background</b>		
Born in Sweden	1454	90.4
Foreign-born	154	9.6
<b>Employment</b>		
Permanent job	1271	79.0
Part time job	235	14.6
Other	102	6.3
<b>Marital status</b>		
Single/Window/Widower	486	30.2
Marriage/Cohabiting	1122	69.8
<b>Branch</b>		
Manufacturing	550	34.4
Construction	192	12.0
Health/social works	193	12.1
Education	96	6.0
Transport	131	8.2
Others	435	27.2
<b>Injury Characteristics</b>		
<b>Injury cause</b>		
Electricity/explosion	21	1.3
Leakage	33	2.1
Collapse, fall or breakage of material	122	7.6
Loss of control	620	38.6
Falls	459	28.5
Body movement without physical stress	65	4
Body movement with physical stress	222	13.8
Other	62	3.9
<b>Injury location</b>		
Head and Neck	316	19.7
Trunk	156	9.7
Upper extremities	518	32.2
Lower Extremities	379	23.6
Others	239	14.9
<b>Year of Injury</b>		
2007 to 2009	702	43.7
2010 to 2012	906	56.3
<b>Hospital Level Factors</b>		
<b>Hospital Regions</b>		
Region 1	41	2.5
Region 2	1317	82.9
Region 3	142	8.8
Region 4	8	0.5
Region 5	11	0.7
Region 6	7	0.4
<b>Admitted From</b>		
Another Hospital/Clinic	54	3.4
Workplace	819	50.9
<b>Admission Destination</b>		
Orthopedics	890	55.3
Other Surgery	452	28.1
Medicine	262	16.3
<b>Discharged Destination</b>		
Another Hospital/Clinic	61	3.8
Home	813	50.6
<b>Patient came in by appointment</b>		
<b>Yes</b>	336	20.9
<b>No</b>	1272	79.1
<b>DRG</b>		
Nervous system	155	9.6
Eyes/ENT/Respiratory/Dermatology	154	9.6
Muskoloskeletal	385	23.9
Others	180	11.2
<b>Total Procedures</b>		
1 procedure	2	15.4
More than one	19	33.4

**Table 2:** Distribution of LOS by demographic, injury and hospital level characteristics

	Hospital Admission >3 days	N	n%	P-value	
<b>Sociodemographic factors</b>					
<b>Age groups</b>					
30 and below	207	33	15.9	0.018	
31-40	171	30	17.5		
41-50	206	47	22.8		
51-60	203	58	28.6		
61plus	87	21	24.1		
<b>Gender</b>					
Female	233	47	20.2	0.529	
Male	641	142	22.2		
<b>Background</b>					
Born in Sweden	790	173	19	0.01	
Foreign-born	84	16	21.9		
<b>Employment</b>					
Permanent job	681	153	22	0.01	
Part time job	136	18	13.2		
Other	57	18	31.6		
<b>Marital status</b>					
Single/Window/Widower	238	52	21.8	0.922	
Marriage/Cohabiting	636	137	21.5		
<b>Branch</b>					
Manufacturing	297	65	21.9	0.188	
Construction	110	22	20		
Health/social works	110	23	20.9		
Education	53	10	18.9		
Transport	68	20	29.4		
Others	236	449	20.8		
<b>Injury Characteristics</b>					
<b>Injury cause</b>					
Electricity/explosion	16	1	6.3	0.93	
Leakage	18	4	22.2		
Collapse	69	19	27.5		
Loss of control	336	66	19.6		
Falls	250	66	26.4		
Movement with load	34	7	20.6		
Movement without load	115	20	17.4		
Other	34	5	14.7		
<b>Injury location</b>					
Head and Neck	224	32	14.3		
Trunk	117	40	34.2		
Upper extremities	204	28	13.7		
Lower Extremities	205	63	30.7		
Others	124	26	21		
<b>Year of Injury</b>					
2007 to 2009	488	105	21.5	0.044	
2010 to 2012	386	84	21.8		
<b>Hospital Level Factors</b>					
<b>Hospital Regional Category</b>					
Region 1	29	4	13.8	0	
Region 2	662	138	20.8		
Region 3	100	34	34.4		
Region 4	5	0	0		
Region 5	9	2	22.2		
Region 6	4	1	25		
<b>Admitted From</b>					
Another Hospital/Clinic	54	26	48.1	0.56	
Workplace/home	819	163	19.9		
<b>Discharged Destination</b>					
Another Hospital/Clinic	61	15	24.6	0	
Home	813	174	21.4		
<b>Patient came in by appointment</b>					
<b>Yes</b>	77	29	37.7	0	
<b>No</b>	797	1600	20.1		
<b>Admission Destination</b>					
Orthopedics	373	101	27.1	0	
Other Surgery	339	73	21.5		
Medicine	158	15	9.5		
<b>DRG</b>					
Nervous system	155	16	10.3	0	
Eyes/ENT/Respiratory/Dermatology	154	26	16.9		
Muskoloskeletal	385	105	27.3		
Others	180	42	23.3		

of over 14 days. LOS longer >3days was mostly significant for injured workers brought in from other hospitals  $\chi^2$  (1)=23.8; p=0.000; injuries on the trunk  $\chi^2$  (4)=35.6; p=0.000; admissions to the orthopedic clinics  $\chi^2$  (2)=20.2; p=0.000, receiving hospital located within region 2,  $\chi^2$  (5)=11.4; p=0.044; musculoskeletal DRG  $\chi^2$  (3)=21.3; p=0.000 and other forms of employment  $\chi^2$  (2)=9.2; p=0.010. These significant variables above were then included in the logistic regressions model.

As indicated in table 3, part time employees admitted for injuries exhibited the least likelihood for LOS >3 days. Injured workers admitted from other hospital had 3.5 fold likelihood to be hospitalized longer than 3 days. Compared to those admitted to medical wards, injured workers admitted to the orthopedic and surgery wards were 4.4 and 3.6 times more prone to longer LOS respectively.

**Table 3:** Relationship between LOS and demographic, injury and hospital level factors; adjusted odds-ratios and confidence intervals

	Odds ratio	CI (Odds ratio)	p-value
<b>Age groups</b>			
30 and below	0.988	0.440-1.839	ns
31-40	0.778	0.383-1.580	
41-50	1.069	0.553-2.065	
51-60	1.327	0.698-2.524	
61plus	1		
<b>Employment</b>			
Permanent job	0.509	0.257-1.008	0.053
Part time job	0.298	0.127-0.704	0.006
Other	1		
<b>Injury location</b>			
Head and Neck	1.35	0.527-3.463	0.532
Trunk	2.068	0.923-4.635	0.078
Upper extremities	0.402	0.189-0.856	0.018
Lower Extremities	1.296	0.586-2.870	0.522
Others	1		0
<b>Hospital Regions</b>			
Region 1	0.722	0.051-10.266	ns
Region 2	1.379	0.124-15.324	
Region 3	1.353	0.114-16.020	
Region 4	0	0	
Region 5	1.021	0.055-18.979	
Region 6	1		
<b>Admitted From</b>			
Another Hospital/Clinic	3.543	1.687-7.441	0.001
Workplace/Home	1		
<b>Patient came in by appointment</b>			
Yes	1.926	0.956-3.869	0.065
No	1		
<b>Admission Destination</b>			
Orthopedics	4.398	1.979-9.775	0
Other Surgery	3.641	1.794-7.388	0
Medicine	1		0
<b>DRG</b>			
Nervous system	0.205	0.075-0.560	0.002
Eyes/ENT/Respiratory/ Dermatology	0.361	0.173-0.753	0.007
Muskoloskeletal	0.601	0.313-1.155	0.127
Others	1		

## Discussion

The current study sought to examine LOS and its associated factors such as individual level factors as well as some that reflect the characteristics of the health care system. Surprisingly some individual factors often known to play significant roles in health outcomes did not remain significant in the multivariate analysis. For example, although younger workers are generally known to have higher occupational injury prevalence [5,18] it appears injuries requiring hospitalization longer than 3 days increased with age up to 51-50 only to decrease in the older age groups in this study. This significance did not remain when other factors were controlled for. The foregoing observation is in contrast to those of Grandjean et al. [5] and Kiumi et al. [19] who found LOS to consistently increase with increasing age for all age groups. Our finding is also in contrast to findings by Ho et al. [20] and Clark et al. [6]. The discrepancy may however be due to methodological differences such as an overrepresentation of certain age groups [19], inclusion of both sicknesses and injuries, focusing on certain types of injuries [20] etc, whereas the present study has focused solely on occupational injury admissions.

The mechanism surrounding the comparatively lower LOS observed here among part-time workers is not clear. Although this may be due to factors such as less injury severity or the direct effect of hospital effort to reduce LOS, other factors such as patients own desire to leave hospital, may not be ruled. The dataset used in this study did not include information regarding discharge in line with or against medical advice; however, previous research shows that employment situation and financial concerns are often connected to patients' desire for early discharge from hospital care, sometimes against medical advice [21]. Individuals with limited financial capacity may feel the need to access financial resources and attend to family needs, both are impossible while still in hospital, thus the desire for a quick discharge from hospital [21]. A Canadian study by Moore et al. [22] however, found increased LOS among people with material deprivation operationalized by employment and income among others. Further studies may be warranted to better understand the role of employment status for LOS.

In line with similar findings by Panagopoulou et al. [23], the prevalence of injuries to the upper extremities was higher than other injury locations; however, upper extremities injury had the least LOS compared to others. One likely reason for this may be due to the fact that other injury locations have longer treatment time and higher risk for disability. For example, Holtslag et al. [24] found that injuries on the lower extremities were directly related to limitations in daily activities and mobility as well as discomfort or pain.

Wu et al. [15] propose that interpretations of findings from studies on LOS must consider the context of the healthcare organization under study. Hospital level factors associated with LOS in this study include admission destination, whether patients arrived due to a scheduled appointment and the



DGR category for their injury. For admission destination, the orthopedics wards received more than 50% of hospitalized occupational injuries followed by other surgical wards. Together, both categories accounted for 83.4% of the total burden of occupational injury requiring hospital admission and 48.6% of LOS greater than 3 days. While this finding gives an indication of injury categories for which workers are most at risk, it also indicates the burden placed on health care by preventable occupational injuries. Patients admitted to orthopedic wards in this study had a fourfold risk for LOS longer than three days compared to others, followed by other surgery (3.6 fold risk), indicating a large burden on both wards. These are similar findings observed by Wu et al. [15]. The extra time needed for expert observation and patient recovery may explain why LOS may be longer for orthopedics and other surgical patients in this study.

The odds of LOS longer than three days were higher for patients referred from other hospitals. Research has shown relatively lower LOS among patients who received early and acute medical intervention [12,13]. While referrals are usually based on injury severity and availability of medical expertise and equipment, these findings may be reflect the extent of availability of relevant trauma or specialist facility at the first hospital of contact. It is thus likely that some hospitals have more burden than others. Patients' medical state at the time of admission has important implications for LOS and eventual prognosis. There are current calls for better training of workplace health care providers in order to improve their skills in basic stabilization and other first aid procedures [5].

With regards to the role of DRG, diagnosis related to the nervous system had the least LOS as well as those of eyes, ENT, respiratory and Dermatology combined, whereas those related to musculoskeletal system had a relatively longer LOS. Although the first listed diagnosis is intended to represent the main reason for admission, there may be shortcomings to the significance of DRGs, two of which stand out. First is that according to Sears et al. [25], billing methods aimed at getting maximum reimbursement may lead to reshuffling of DRGs [25]. Morin et al. [26] discussed the tendency for overproduction of profitable DRGs. This sort of practice may lead to disparities in LOS and consequent health outcomes following injury if patients do not get healthcare commiserate with their condition. The second shortcoming is that since DRG system reimburses hospitals with a lump sum irrespective of their LOS and other costs associated with patient care [27], it is likely to place pressure on hospital to reduce LOS [28,29]. The DRGs were regrouped into three broad categories for ease of analyses in this study; findings should thus be interpreted with caution.

The strength of the current study is its relatively large sample size and the source of the dataset. Some limitations may however lie on the large dependence on codes and classification, e.g. DRGs and ICD codes, some of which may be largely subjective. There are currently discussions concerning

the risk of misclassification of cases when using ICD code [19]. Another limitation worthy of note is the non-inclusion of injury severity and co-morbidity in the statistical model in order to determine their roll. The limitations notwithstanding, findings from this study may be useful occupational health promotion and hospital management.

## Conclusion

This study shows that in addition to individual level factors such as employment status and injury location, hospital level factors were important significant determinants of LOS for occupational injuries. Hospital level factors such as referrals and admitting ward remained significant predictors of LOS even after controlling for other factors. Though it may be argued that hospital level factors (e.g. admitting wards), are determined by specific individual factor (e.g. injury type and location), the role of purely administrative and resource saving factors at the hospital level can however not be ruled out. Thus, it is not clear if the mean LOS i.e. approximately 3 days, observed in this study is an indication of improved trauma care, or an outcome of efforts to cut down on LOS with a potential risk of increased mortalities outside the hospital (as observed by Nordström et al. [16]). There are ongoing discussions for [27] and against [28] short LOS. However, LOS should be more adapted to patients' general conditions in order to ensure effective recovery and return to work, as well as prevent readmissions and mortalities. Thus in addition to suggestions for improved occupational health practices, a closer look into current hospital practices to improve patient care is necessary as well.

## Statement of Conflict of Interests

None declared.

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## Adherence to ethical recommendations

This study adheres to the recommendations and standards of the Helsinki declaration.

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