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The Incidence, Prevalence, Costs and Impact on Disability of Common Conditions Requiring Rehabilitation in the US: Stroke, Spinal Cord Injury, Traumatic Brain Injury, Multiple Sclerosis, Osteoarthritis, Rheumatoid Arthritis, Limb Loss, and Back Pain

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Abstract

Objective—To determine the relative incidence, prevalence, costs and impact on disability of 8 common conditions treated by rehabilitation professionals.

Design—Structured review of the literature

Setting—United States

Participants—N/A

Interventions—N/A

Main Outcome Measures—disease associated incidence, prevalence, direct and indirect costs and impact on activity and work limitations.

Results—Back pain and arthritis (osteoarthritis and rheumatoid arthritis) are the most common and costly conditions that we examined, affecting over 100 million individuals and costing over \$200 billion per year. Traumatic brain injury, while less common than arthritis and back pain, carries enormous per capita direct and indirect costs, mostly due to the young age of those involved and the severe disability that it may cause. Finally, stroke, which is often listed as the most common cause of disability, is likely second to both arthritis and back pain in its impact on functional limitations.

Conclusions—Of the common rehabilitation diagnoses we studied, musculoskeletal conditions such as back pain and arthritis likely have the most impact on the health care system due to their high prevalence and impact on disability.

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Keywords

Incidence; prevalence; direct costs; indirect costs; stroke; spinal cord injury; traumatic brain injury; multiple sclerosis; osteoarthritis; rheumatoid arthritis; limb loss; back pain; disability

In 2011, there were an estimated 37.9 million people, 12.2% of the US population, living with a disability.¹ The impact of disability is significant. Aside from the enormous direct medical costs related to disability,² which were estimated at \$160 billion in 1994,³ medical problems have considerable personal and societal impact. Medical costs account for over 60% of all personal bankruptcies.^{4, 5} One hundred and ninety-five billion dollars in earnings and taxes are also lost each year because of unemployment or under-employment.⁶ Government and private payments to support employment-age individuals with disabilities who do not have jobs are also estimated at \$232 billion per year.⁷ These figures may rise with the aging of the US population.

With many demographic changes looming, it is important to understand the ongoing impact of disability. Quantifying the national burden of disability is integral to understanding its impact on society and can help direct clinical resources. In addition, given the increasing limited funding for research, these data may help us direct rehabilitation research funds to specific areas.

Toward this end, we have assessed eight common disabling conditions which might be treated in an inpatient or outpatient rehabilitation setting. Our overall purpose is to: 1) to characterize the incidence, prevalence, costs across eight disabling conditions, and (2) to compare the impact of disability attributable to these conditions on activity and work limitation.

Methods

The eight conditions covered in this review were chosen based on the fact that they are commonly in need of inpatient and outpatient rehabilitation care.⁸ They include: spinal cord injury, traumatic brain injury, back pain, osteoarthritis, rheumatoid arthritis, multiple sclerosis, stroke, and limb loss.

There are few national guidelines for assessing the economic and social burden of disability. This paper is an attempt to organize the differing methods, cost measures, and data sources in the available literature. The authors conducted a Medline search for reviews and primary studies. Multiple search terms were used: “cost, disability, socioeconomic, work, impact, burden, epidemiology, United States” as well as the particular condition being studied. Titles and abstracts were read to exclude duplicates and studies which did not address the research questions. The authors supplemented their Medline search with Google Scholar, UpToDate, Centers for Disease Control and other data available online. The overall search results and selection methods are presented in the PRIMSA flowchart in Figure 1. Details for each condition, as well as the specific search terms applied, are included in Table 1 (Appendix A) which is available online.

Inclusion criteria: Published (not in-press or online before publication) between 2008 and 2013, selected conditions (older publications found within the references of articles from this period were included if they were primary sources for the most recent figures available), disability-relevant outcome measure, work-relevant outcome measure, cost-relevant outcome measure, original research with primary data, and review articles. Exclusion criteria: Non-English language, non-US subject population, studies without an outcome measure relevant to: incidence, prevalence, work, disability, or cost.

Since the data we present spans a more than a decade, we inflation-adjusted selected dollar figures to April 2013 values using the Consumer Price All-Items Index when assessing indirect and total costs, and the April 2013 Consumer Price Medical Index for direct costs.³ This gives the reader a better ability to compare costs between one condition and the next.

Results

After our structured review of the literature, we identified 173 papers of interest, over 65 of which are cited here. Almost all were analyses of national or regional surveys. Pertinent results for all 8 conditions may be found in Table 2.

Back Pain

Back pain is a very common condition, with an incidence of 139 per 100,000 person-years in the United States based on data from the National Electronic Injury Surveillance System.⁹ A 2011 publication by the Center for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS) reported that 28.4% of adults over age 18 had experienced lower back pain in the previous three months.¹⁰ This figure is at the high end of the findings of a systematic review of 15 studies between 1997 and 2007, in which reported annual rates of low back pain in the range of 5–22%.¹¹ Based on data from the 2005 Survey of Income and Program Participation (SIPS), 7.6 million adults with disabilities identified back or spine problems as the main cause of their disability.¹²

Back pain significantly limits work and daily activity. According to data from the 1998 National Health Interview Survey (NHIS), Americans lost a cumulative 149 million workdays due to back pain in 1988.¹³ In the nationally representative Medical Expenditure Panel Survey, 24.7% of people with back problems reported limitations in their physical functions.¹⁴ Over seven million adults have activity limitation due to chronic back conditions,¹⁵ according to the National Arthritis Data Workgroup's analyses of the National Health and Nutrition Examination Survey (NHANES) and the NHIS.

The high prevalence of lower back pain comes with considerable economic costs. In 2006, Katz estimated the total cost of back pain in the United States to be \$100–200 billion (\$119–238 billion in 2013 dollars), with 1/3 accounted for by direct medical expenses and the remaining 2/3 due to indirect costs from productivity loss and absenteeism.¹⁶ However, the authors made this estimate by extrapolating data from a 15-year-old study.¹⁷ Perhaps for this reason, these cost breakdowns produce higher estimates for direct cost than a more recent study which estimated direct costs at \$46.8 billion per year in 2013 dollars, although this study counted only ambulatory services for chronic pain.¹⁸ An earlier study produced lower

estimates for indirect costs as well, using data from the American Productivity Audit of 28,902 working adults to derive an annual figure of \$19.8 billion (\$25.6 billion in 2013 dollars).¹⁹

Arthritis (Osteoarthritis and Rheumatoid)

Osteoarthritis is one of the most common diagnoses in general practice and is probably the leading cause of disability in adults. Based on national census data and the NHANES I, osteoarthritis affected 26.9 million adults in 2005.¹⁵ Even higher estimates came from the 2003–2005 NHIS, which found that 21.6% of US adults, or 46.4 million Americans, self-reported a history of arthritis.²⁰ The same group used the 2005 SIPS to establish that 8.6 million US adults with disabilities attributed the main cause of their disability to arthritis or rheumatism.¹²

Disability attributable to osteoarthritis can be assessed by lost work days and limitations in activities of daily living. According to the American Academy of Orthopedic Surgeons, about 80% of adults with osteoarthritis have some degree of movement limitation. About 25% are restricted in major activities of daily living, including 14% who need help with routine needs and 11% who need help with personal care.²¹ A study based on NHIS data from 2007–2009 reported that 21.1 million, or 42% of the 49.9 million adults with doctor-diagnosed arthritis, had arthritis-attributable activity limitations (AALs).²² AALs were defined as limitations in whether individuals work, the type of work they can do, or the amount of work they can do.

Rheumatoid arthritis is estimated to be present in 1.3 million US adults 18 years of age or over, representing 0.6% of the population, based on NHIS- and NHANES-derived analyses from the National Arthritis Data Workgroup.²³ In 2011, Jacobs reported higher estimates of 2% of adults in North America.²⁴ The most recent estimate of the incidence of rheumatoid arthritis is 41 per 100,000 person-years based on the Rochester Epidemiology Project.²⁵ Rheumatoid arthritis is also associated with significant disability. People with rheumatoid arthritis are 30% more likely to need help with personal care and are limited in daily activities at twice the rate of disease-free individuals.²⁶ One study followed employees with early-stage rheumatoid arthritis, and found a 39% prevalence of work disability after 10 years.²⁷

The economic burden of all arthritis is significant. In 2007, the cost attributable to arthritis and other rheumatic conditions in the United States was estimated at \$128 billion (\$162 billion in 2013 dollars).²⁸ This estimate, derived from national Medical Expenditure Panel Survey (MEPS) data, was partitioned into \$80.8 billion (\$115 billion in 2013 dollars) in direct medical expenditures and \$47.0 billion (\$59.4 billion in 2013 dollars) in indirectly lost earnings. In 2010, Kotlarz used MEPS data from the same period and estimated that the costs due to absenteeism from osteoarthritis alone are \$10.3 billion per year (\$11.6 billion in 2013 dollars), due to an estimated three lost workdays per year.²⁹

The functional and work limitations of rheumatoid arthritis contribute to an estimated \$10.9 billion (\$13.0 billion in 2013 dollars) in indirect costs from lost wages and costs to employers, based on 2005 administrative claims databases covering private and Medicare/

Medicaid beneficiaries in the United States.³⁰ On top of this figure, the group attributed an additional \$10.3 billion (\$12.3 billion in 2013 dollars) in intangible quality-of-life deterioration as estimated by legal system jury awards, as well as \$9.6 billion lost (\$11.4 billion in 2013 dollars) in lifetime earnings due to early mortality. Excess health care costs, in the form of co-pays and medications, amounted to \$8.4 billion (\$10.6 billion in 2013 dollars), for a total indirect cost of \$39.2 billion per year (\$46.7 billion in 2013 dollars).

Stroke

Stroke is a leading cause of serious long-term disability in the United States. According to the National Heart Lung and Blood Institute (NHLBI), the incidence of stroke is 795,000 annually, with 610,000 being first-time strokes and 185,000 related to a recurrence.³¹ The American Heart Association also estimated an overall stroke prevalence of 6.8 million Americans 20 years old, accounting for 2.8% of the population, based on NHANES data from 2007–2010.³²

Among older survivors of ischemic stroke who were followed in the Framingham Study, 26% were dependent in activities of daily living six months post-stroke. Half had reduced mobility or hemiparesis, including 30% who were unable to walk without assistance. In addition, a significant number had associated aphasia (19%), symptoms of depression (35%), and other impairments which contributed to a 26% rate of nursing home placement.³³

The economic burden of stroke is impacted by initial hospitalization, medications, continuing medical care, and work limitations. The average cost of a stroke hospitalization in 2005 was \$9,500.³⁴ Over a lifetime, the cost of an ischemic stroke in the United States is over \$140,000 including inpatient care, rehabilitation, and long-term care for lasting deficits.³⁵ A 2011 estimate divided the total cost of stroke in the US into \$28.3 billion (\$33.0 billion in 2013 dollars) for direct costs and \$25.6 billion (\$27.3 billion in 2013 dollars) in indirect costs.³⁶ Estimates for the total costs for strokes in the United States range from \$34.3 billion (\$36.6 billion in 2013 dollars)³⁷ to \$65.5 billion (\$72.7 billion in 2013 dollars).³⁸

Traumatic Brain Injury

A 2010 report from the CDC estimated that traumatic brain injury requiring physician a visit occurs with an incidence of 1.74 million per year in the United States, based on calculations from NHIS data by Waxweiler et al in 1995.³⁹ The severity of traumatic brain injury ranges from mild (80%) to severe (10%), with most long-term disability caused by moderate to severe injury.⁶ The prevalence of long-term disability resulting from TBI has been estimated at 3.32 million⁴⁰ to 5.3 million⁴¹ in the US.

Survivors of traumatic brain injury often have limitations in activities of daily living, instrumental activities of daily living, social integration, and financial independence.^{42,43} About 43% of people discharged with TBI following acute hospitalization develop TBI-related long-term disability.⁴⁴ Individuals with a history of TBI are 66% more likely to receive welfare or disability payments.⁴³ In addition, a history of TBI is strongly associated

with subsequent neurological disorders which are disabling in their own right, including Alzheimer's disease and Parkinson's disease.⁴⁵

The direct costs of TBI have been estimated at \$9.2 billion per year (\$13.1 billion in 2013 dollars). An additional \$51.2 billion (\$64.7 billion in 2013 dollars) is lost through missed work and lost productivity.⁴⁴ Total medical costs range from \$48.3 billion to \$76.5 billion (\$63.4 to \$79.1 billion in 2013 dollars).^{46–48}

Limb Loss

The loss of a lower or upper extremity is associated with variable degrees of disability, given the wide range of co-morbidities and inciting factors leading to amputation. Approximately 185,000 amputations occur in the United States annually,⁴⁹ and an estimated 2 million Americans currently live with limb loss.⁵⁰ The most common causes of limb loss are diabetes and peripheral artery disease, with an age-adjusted incidence rate of 3.1 per 1,000 for people with diabetes in 2009.⁵¹ In 2006, about 65,700 non-traumatic lower-limb amputations were performed in people with diabetes.⁵² Trauma accounts for 45% of all cases, with cancer accounting for <1% of amputations.⁵⁰

Cardiovascular disease is itself a significant cause of disability and mortality in the United States, and when present as a co-morbid condition in people with limb loss, contributes to worse disability and mortality outcomes. Nearly half of people who have an amputation due to vascular disease will die within five years.⁵³

In addition to serious co-morbidities like vascular disease, a number of risk factors have been found to be significantly associated with poorer functional outcomes and decreased rates of independent living status following amputation. These include age >60 yrs, above-knee amputation, baseline homebound status, and dementia.⁵⁴ However, most patients who lived independently prior to major lower limb amputation remained independent postoperatively.⁵⁴ In 2003, an average diabetes-related amputation procedure carried \$38,077 (\$54,317 in 2013 dollars) in associated costs.⁵⁵ In 2009, cumulative national hospital costs associated with amputation amounted to over \$8.3 billion (\$9.0 billion in 2013 dollars).^{56, 57}

Multiple Sclerosis

A recent study found a rate of approximately 2.0 cases of multiple sclerosis per 100,000 person-years in men and 3.6 cases per 100,000 person-years in women.⁵⁸ In 2007, the National Multiple Sclerosis Society estimated the prevalence at 400,000 by using Census 2000 data to extrapolate from earlier estimates.⁵⁹

Disability attributable to multiple sclerosis is highly variable given its wide range of clinical presentations. The average time between disease onset and difficulty in ambulation is eight years. Without disease-modifying treatment, patients require a cane, on average, after 15 years, and are using a wheelchair, on average, after 30 years.⁶⁰ During the period of decline in functional ability, there is an accompanying decline in the ability to remain in the labor force, with employment rates declining an average of 3% per year following diagnosis.⁶¹

Annual health care costs for patients with multiple sclerosis have been reported to be between \$18,000 (National Multiple Sclerosis Society) and \$39,000 per person.⁶⁰ The National Multiple Sclerosis Society estimates that the annual economic cost in the United States was approximately \$28 billion.⁵⁹ Among patients with healthcare insurance, out-of-pocket costs are close to \$2,000 per year. However, 25% of people pay more than this amount each year.⁶² A survey of 2,314 randomly selected bankruptcy filers in 2007 found that out-of-pocket expenditures for neurological diseases like multiple sclerosis accounted for the highest medical bills at an average of \$34,167 per person, exceeding expenditures for diabetes, stroke, mental illness, and heart disease.⁴

Spinal Cord Injury

Based on several regional studies, the annual incidence of spinal cord injury in the United States is estimated to be between 24⁶³ and 77⁶⁴ per million people, or roughly 12,000 to 20,000 new cases per year.⁶⁵ Motor vehicle accidents account for the majority of cases, and 80% of affected individuals are male. It is estimated that there are approximately 270,000 living survivors of spinal cord injury in the US, with a range of 238,000 to 332,000 people.⁶⁵

The limitations of a spinal cord injury on activities of daily living are largely determined by the location and completeness of the injury sustained.⁶⁶ The higher the level of spinal cord injury, the more assistance the patient will need for activities of daily living (ADLs) and locomotion. Although there are many exceptions, patients are generally independent in all self-care if their injury occurs at spinal level T1 or below. Patients with a low cervical injury (C6–C8) may require additional bowel and bladder care and bathing with adaptive equipment, while a patients with high cervical injury have an increased dependency on oral functioning for hygiene, writing, and typing and operating a power wheelchair.⁶⁶

In one model system, more than half (57.1%) of all people with spinal cord injury reported being employed prior to their injury, but this number fell to 11.8% one year later.⁶⁵ With physical and occupational therapy, many patients are able to regain much of their ability to care for themselves and re-enter the workforce. By twenty years post-injury, the same cohort of patients had a 35.2% employment rate.

Costs associated with spinal cord injury are greatly influenced by the patient's severity of injury and resultant degree of disability.⁶⁵ In 2011, average per-person yearly expenses ranged from \$334,170 in the first year and \$40,589 in each subsequent year for patients with incomplete injury, versus \$1,023,924 in the first year and \$177,808 in each subsequent year for patients with C1–C4 tetraplegia.⁶⁷ The total annual cost attributed to spinal cord injury in the United States is approximately \$14.5 billion (\$21.5 billion in 2013 dollars).⁶⁸ Estimates for direct costs range from \$7.73 billion (\$14.0 billion in 2013 dollars)⁶⁹ to \$9.73 billion (\$18.1 billion in 2013 dollars),⁶⁸ while estimates for indirect costs range from \$2.59 billion (\$3.83 billion in 2013 dollars)⁶⁸ to \$5.5 billion (\$7.0 billion in 2013 dollars).⁶⁵

Discussion

Our review of the literature suggests that back pain and arthritis are the most common and costly conditions that we examined, affecting over 100 million individuals and costing over \$200 billion per year. Another condition to note is traumatic brain injury, which, while less common than arthritis and back pain, carries enormous per capita costs, mostly due to the disability that it may cause. Finally, stroke, which is often listed as the most common cause of disability,³¹ is likely second to both arthritis and back pain in its impact on functional limitations. This is consistent with evidence from the UK.⁷⁰

Back pain and arthritis make their impact by sheer numbers in the population. Even if each affected individual misses just few days of work on average, or has their productivity slightly impaired, the cumulative results across the affected population can amount to tens of billions of dollars in lost wages and reduced work capacity each year. Conversely, interventions that make small improvements in the onset and progression of these chronically disabling diseases may result in significant overall healthcare cost savings.

Other conditions may affect a smaller number of people, but can severely limit their ability to work, ambulate, or take care of themselves. In conditions like spinal cord injury or limb loss, the degree of each person's specific impairments results in widely differing costs of care and levels of disability. Because conclusions are relatively difficult to make about conditions like spinal cord injury and amputation as an aggregate group, it is important for future research to focus on the evaluation of, and creation of specific interventions for, thoughtfully delineated subsets of these populations.

The high direct and indirect costs of disability are likely related to the chronic nature of functional loss. A comparison of the rates of first-time versus recurrent stroke, or the incidence versus prevalence rates of spinal cord injury and traumatic brain injury highlight the continual burden of these conditions beyond their initial impact. Although direct medical costs tend to be highest in the first year after event onset, they can remain high throughout a patient's lifetime. Without a comprehensive view of the lifelong costs of chronic disability, medical costs may continue to account for the majority of bankruptcies in this country.

Study Limitations

This paper has several limitations. First of all, while we searched for the latest and best available research, some of the data we examined is over a decade old. Inflation adjustments over this period of time may be less accurate. In addition, the costs were not estimated in a uniform fashion, raising the possibility that there might be differential error between diagnostic groups. We also used single inflation adjustment metric, and there is no question that inflation may have been different for different conditions. Although subtle variations in disease specific inflation may exist, it is unlikely that adjusting for the “true” inflation rates (if this were even possible) would change our conclusion related to the question of which diseases are most expensive. Back pain and arthritis are clearly the most expensive and this is primarily on the basis of their high prevalence rather than their per capita cost. Finally, patients often present with more than one diagnosis. While our table does appear to attribute all the cost and disability to a single diagnosis, this may not be the case. Individuals with

stroke may also have an amputation or arthritis, and this may be the source for some of their disability. Thus, there is likely a much more subtle interplay at work that is beyond the scope of this paper.

Conclusions—The limitations noted above highlight the problems in performing this sort of review. In many cases, the data are old and there is a lack of uniformity in how certain elements, particularly costs and disability burden, are measured. Thus, it is problematic when one wants to compare one time point to the next as well as one disease to another. One solution, although an expensive one, would be to invest more resources in comprehensive national surveys that address the issues raised in this paper. In particular, data on the measurement of disability seemed to be the most lacking in our search and this may be a topic that deserves special focus.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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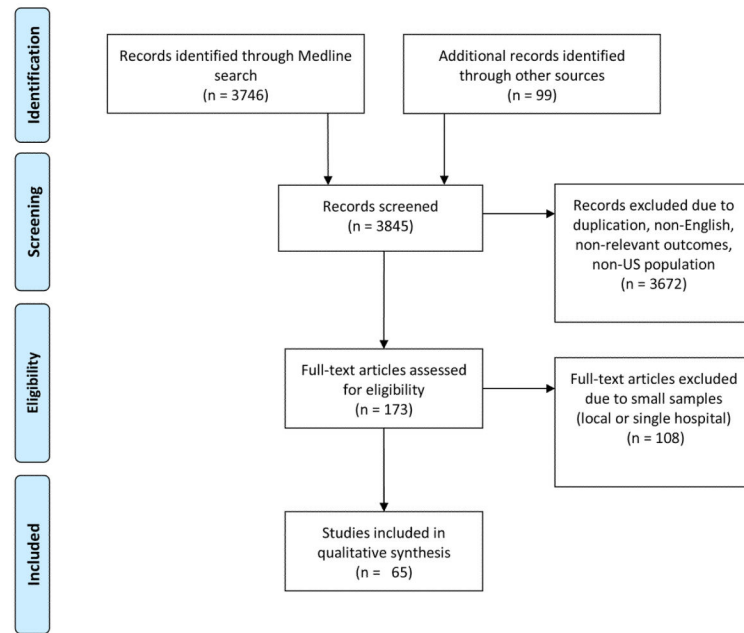


Figure 1.
PRISMA Flow Diagram

Table 1

	Prevalence	Incidence	Annual Direct Cost (2013 values in parentheses)	Annual Indirect Cost (2013 values in parentheses)	Annual Total Cost (2013 values in parentheses)	Activity Limitation	Work Limitation
Back Pain	59.1 million adults (age ≥ 18 have had back pain within the last 3 months (Lawrence, 2008) Of all those in US over age 18 living in the community, 28.9% have had low back pain and 15.5% have had neck pain within the last 3 months (NCHS, 2011)	139 per 100,000 person-yr (Waterman, 2012)	\$33.3–\$66.7 billion (Katz, 2006) \$12.2 (\$22.7) billion (Druss, 2002) \$17.9 (\$23.4) billion (Smith, 2013)	\$66.7–\$133.3 billion (Katz, 2006) \$7.4 (\$9.1) billion (Ricci, 2006) \$13.9 (\$21.2) billion (Guo, 1999) \$19.8 (\$25.6) billion (Stewart, 2003)	\$100–200 billion (Katz, 2006) \$90.6 (\$129.2) billion (Luo, 2004)	24.7% of people with back pain self-report functional limitations. (Martin, 2008) 7.1 million adults age 18 and older have activity limitation due to chronic back conditions. (Lawrence, 2008)	149 million lost work days per year (Guo, 1995)
Osteoarthritis	49.9 million adults age 17 in 2009 (Cheng, 2010) 46.4 million adults age 18 in 2000; 21.6% of adults (Hootman, 2006) 26.9 million adults age 25 in 2005 (Lawrence, 2008) Main cause of disability in 8.6 million adults age 18 (Hootman, 2012)	88 /100,000 person-yr (hip); 240/100,000 person-yr (knee); 100/100,000 person-yr (hand) (Oliviera, 1995)	\$80.8 (\$115.3) billion (Yelin, 2007)	\$10.3 (\$11.6) billion (Kotlarz, 2010) \$8.3 (\$13.0) billion (Leigh, 2001)	\$128 (\$161.8) billion (Yelin, 2007) \$89.1 (\$139.8) billion (Leigh, 2001)	42% of people with OA report arthritis-attributable activity limitations. (Cheng, 2010)	5.3% of working age adults have arthritis attributable work limitations (Theis, 2007) 3 lost workdays per year per person (Kotlarz, 2010)
Rheumatoid Arthritis	1.3 million adults 18 in 2005 (Helmick, 2008) 2% of adults in North America (Jacobs, 2011) 0.5–1.0% of general population (Silman, 2001)	41 per 100,000 person-yr (Myasoedova, 2010)	\$8.4 (\$10.6) billion (Birnbaum, 2010)	\$30.8 (\$36.7) billion (Birnbaum, 2010)	\$39.2 (\$46.7) billion (Birnbaum, 2010)	30% more likely to need help with personal care; twice as likely to have a health-related activity limitation (Dominick, 2004)	44% 10-year work disability prevalence. (Sokka, 1999) 39% unable to work 10 years after early-stage RA. (Eberhardt, 2007)
Stroke	6.8 million adults age 20; 2.8% of adult population (Go, 2013)	795,000/yr (610,000/yr for first stroke) (Go, 2013)	\$28.3 (\$33.0) billion (Heidenreich, 2011) \$18.8 (\$21.9) billion (Roger, 2012)	\$25.6 (\$27.3) billion (Heidenreich, 2011) \$15.5 (\$16.5) billion (Roger, 2012)	\$65.5 (\$72.7) billion (Rosamond, 2007) \$34.3 (\$36.6) billion (Roger, 2012)	Among stroke survivors age 65, 26% were dependent in ADLs, 50% had hemiparesis, 30% were unable to walk without assistance, 19% had aphasia, 26% were in a	35% unable to work at 1 year following a first cerebral infarct. (Camerlingo, 2000)

	Prevalence	Incidence	Annual Direct Cost (2013 values in parentheses)	Annual Indirect Cost (2013 values in parentheses)	Annual Total Cost (2013 values in parentheses)	Activity Limitation	Work Limitation
Traumatic Brain Injury	3.32 million with long term disability; 1.1% of total population in 2005 (Zaloshnja, 2008)	1.7 million/yr resulting in 52,000 deaths; 275,000 hospitalizations and 1.365 million emergency room visits (Paul, 2010) 538.2 cases per 100,000 population; 1,565,000 in 2003 (Rutland-Brown, 2006)	\$9.2 (\$13.1) billion (Rutland-Brown, 2006)	\$51.2 (\$63.9) billion (Rutland-Brown, 2006)	\$76.5 (\$78.1) billion (Coronado 2012) \$56 (\$69.9) billion (Selassie, 2008) \$48.3 (\$62.2) billion (Finkelstein, 2006)	nursing home 6 months post-stroke (Kelly-Hayes, 2003) nursing home 6 months post-stroke (Kelly-Hayes, 2003) 43% of persons discharged after acute TBI hospitalizations develop long-term disability. (Rutland-Brown, 2006)	Return to work rates 12%–70% depending on the population (Shames, 2007)
Amputation	1.6 million in 2005. (Ziegler-Graham, 2008)	30,000–50,000 lower limb amputations per yr (Ziegler-Graham, 2008) 550 per 100,000 in people with diabetes (CDC, 2009)	Partial foot–\$30,493 (\$45,250) Through knee \$81,086 (\$120,320) (MacKenzie, 2007) \$38,077 (\$54,317) average for diabetes-related amputation (Shearer, 2003)	\$64,000 (\$75,000) per person over 3 years (Shearer, 2003)	\$8.3 billion (\$9.0 billion) (Amputee Coalition, 2013) \$509,275 (\$649,953) lifetime healthcare cost following lower extremity amputation (MacKenzie, 2007)	31% of patients unable to live independently at 24 months. 49% loss of ambulation. (Taylor, 2005) 43–74% five-year mortality following lower extremity amputation. (Robbins, 2008)	42% unable to work 7 years post amputation for lower extremity trauma (MacKenzie, 2006)
Multiple Sclerosis	400,000 (National Multiple Sclerosis Society, 2009) 350,000 (Frohman, 2003) 58 to 95 per 100,000 individuals, (Noonan, 2010)	10,400 cases per year (National Multiple Sclerosis Society, 2009) 3.6 per 100,000 person-years in women; 2.0 per 100,000 person-years in men (Alonso, 2008)	\$16 (\$18) billion (National Multiple Sclerosis Society, 2009) \$54,244 per person (\$60,078) (Adelman, 2013) \$39,000 per person (Fox, 2010)	\$12 (\$13) billion (National Multiple Sclerosis Society, 2009)	\$28 (\$30) billion (National Multiple Sclerosis Society, 2009)	Average time from disease onset to difficulty walking is 8 years; 15 years for cane use; 30 years for wheelchair use (Fox, 2010)	Overall, 56.5% unemployment in MS population. Decline in the ability of people with MS to remain in the labor force declines 3% per year following diagnosis (Minden, 2006)
Spinal Cord Injury	236,000 to 327,000 in 2012 (National Spinal Cord Injury Center, 2013)	43–77 per million; 12,000 to 20,000 per year (Bernhard, 2005)	\$7.1 (\$10.0) billion (Berkowitz, 1998) \$7.73 (\$21.5) billion (DeVivo, 1997) \$500,000 to \$2 million over a lifetime (Sekhon, 2001)	\$2.6 (\$3.7) billion (Berkowitz, 1998)	\$9.7 (\$13.7) billion (Berkowitz, 1998)	functional recovery following depends on severity and spinal level (Braddom, 2000)	81% of previously employed people were unemployed at 1 year post SCI; 39.5% remained unemployed by 25 years post injury (National Spinal Cord Injury Center, 2013)

	Prevalence	Incidence	Annual Direct Cost (2013 values in parentheses)	Annual Indirect Cost (2013 values in parentheses)	Annual Total Cost (2013 values in parentheses)	Activity Limitation	Work Limitation
			Mean first yr charges Mean first yr charges Mean first yr charges Mean first yr charges Mean first yr charges	\$523,089, subsequent \$523,089, subsequent \$523,089, subsequent \$523,089, subsequent \$523,089, subsequent	\$79,759 (De Vivo, 2011) \$79,759 (De Vivo, 2011) \$79,759 (De Vivo, 2011) \$79,759 (De Vivo, 2011) \$79,759 (De Vivo, 2011)		