Chapter 2
Prevalence and Societal Burden of Hip Osteoarthritis

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Introduction

Between 1996–1998 and 2004–2006, the number of individuals reporting a musculoskeletal disease increased by nearly 14 million from the 76 million reported in 1996 [1]. Of the major subgroups of musculoskeletal diseases, arthritis and joint pain have the highest occurrence, reflecting the overall aging population [1]. Arthritis is the most common cause of severe long-term pain and physical disability, and can also affect the psychosocial status of afflicted people as well as their families and careers [2]. From 2007 to 2009 data show that one in nine, or 21 million U.S. adults, had arthritis-attributable activity limitations [3]. OA is the most common type of arthritis and frequently affects the hip. OA of the hips results in pain and stiffness and often leads to significant problems with mobility and disability requiring expensive total hip replacement [4]. OA causes pain and contributes to diminished function reflected in reduced muscle strength, range of motion, and joint instability. Patient-reported outcomes measures have described OA having a major impact on activities of daily living, leading to severe limitations in participation in physical activity, and a decreased quality of life for patients [5].

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Osteoarthritis of the Hip

Prevalence

The prevalence of OA is difficult to determine because *symptoms* of OA (joint pain, swelling, and stiffness) do not always correlate with the *pathology* of OA [6]. The occurrence of pain associated with joint degeneration varies widely among joints and among individuals [7]. The incidence of either radiographic or symptomatic OA increases considerably with age [8–10].

Individuals with advanced degeneration of the joints may have minimal pain and disability, and for this reason, investigations of the prevalence of OA based on evidence of joint degeneration, such as imaging studies or direct inspection of joints, yield larger numbers of affected individuals than do studies that require evidence of joint degeneration and joint pain together for the diagnosis of OA [11, 12]. Recent information on the epidemiology of OA originates from population-based radiographic surveys [13]. Population-based studies in the US suggest prevalence rates comparable to those in Europe, increasing from 1 % for severe radiographic disease among people aged 25–34 to 30 % in those aged 75 and above [13]. In 1997, a study in the Netherlands demonstrated that of the 1040 participants aged 55–65, only 135 (13 %) were free from radiographic evidence of OA [14].

While most studies have focused on information from radiographic OA, there is increasing interest in the prevalence of symptomatic OA. This is important in order to determine the healthcare needs and options for patients. Symptomatic OA affects nearly 27 million Americans and is the leading cause of disability in the US [15, 16].

Using the Johnston County Osteoarthritis Project (JoCo), a longitudinal population-based study of OA in North Carolina, Murphy et al. used a logistic regression analysis to evaluate the lifetime risk of symptomatic hip OA (defined as the proportion of individuals who developed symptomatic hip OA in at least one hip by 85, among those who lived to age 85). They found the overall lifetime probability for developing symptomatic hip OA was 25.3 % (total $n = 3068$, ineligible $n = 321$ women who were <50 years old, eligible $n = 2756$), suggesting that one in four Johnston County residents who live to age 85 are at risk of developing symptomatic hip OA [17]. In another JoCo study, Jordan et al. used weighted prevalence estimates to report contemporary evaluations for four hip outcomes; (1) Hip symptoms, which were assessed separately for right and left sides of the body by the following question: “On most days, do you have pain, aching, or stiffness in your (right, left) hip?” Hip symptoms were defined for analysis as an affirmative response to this question in at least 1 hip; (2) Radiographic hip OA, defined for analysis as Kellgren–Lawrence (K–L) grade of at least 2 in at least 1 hip; (3) Moderate/severe radiographic hip OA, defined as K–L grade 3 or 4 in at

least 1 hip; and (4) Symptomatic hip OA, defined as the presence of hip symptoms in at least 1 hip with corresponding radiographic hip OA in that joint [18]. Jordan et al. reported that of the 2997 participants in their study (total cohort = 3068, missing data $n = 71$), 1078 (36 %) reported hip symptoms, 827 (27.6 %) had radiographic hip OA, 291 (9.7 %) had symptomatic hip OA, and 75 (2.5 %) had severe radiographic hip OA [18]. The prevalence of these four outcomes was consistently and significantly higher for older age groups [18]. Three outcomes (hip symptoms, radiographic hip OA, and symptomatic hip OA) were significantly higher among women compared to men (Table 2.1) [18]. Two outcomes (radiographic hip OA, symptomatic hip OA) were significantly higher among African-Americans than among Caucasians [18]. The prevalence of three outcomes (radiographic hip OA, symptomatic hip OA, and moderate/severe radiographic hip OA) was higher in those aged 75 years or older and occasionally for those aged 65–74, compared to younger ages in both sex and racial groups [18]. Women had greater prevalence of hip symptoms than did men in both racial groups (Table 2.2) [18].

Table 2.1 Weighted prevalence for four hip outcomes, all participants and by selected demographic subgroups, Johnston County Osteoarthritis Project, 1991–1997[a]

Demographic subgroup	Hip symptoms		Radiographic hip OA		Symptomatic hip OA		Severe radiographic hip OA	
	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI
All participants	36.2	34.7, 37.8	27.6	26.3, 28.9	9.7	8.9, 10.6	2.5	2.2, 3.0
Age group								
45–54	30.7	28.5, 33.0	21.2	19.0, 25.1	8.9	7.5, 10.5	1.4	0.8, 2.4
55–64	35.9	33.6, 38.3	23.0	21.1, 25.1	8.9	7.5, 10.5	1.1	0.8, 1.6
65–74	40.7	38.1, 43.4	31.1	28.9, 33.4	10.8	9.4, 12.5	3.6	2.8, 4.6
75+	42.3	38.3, 46.3	42.9	39.2, 46.7	17.0	14.6, 19.6	5.7	4.3, 7.5
Sex								
Men	31.8	29.8, 33.8	25.4	23.6, 27.3	8.3	7.2, 9.5	2.6	2.0, 3.2
Women	39.5	37.7, 41.5	29.5	27.8, 31.3	11.1	9.9, 12.3	2.5	2.1, 3.1
Race/ethnicity								
Caucasian	36.0	34.3, 37.8	26.6	25.1, 28.1	9.2	8.3, 10.2	2.4	2.0, 3.0
African American	37.1	34.9, 39.4	32.1	29.9, 34.4	12.0	10.3, 13.9	3.1	2.5, 4.0

[a]Weighted to the 1990 target population. Radiographic data were available for women only age 50 years and older [Reprinted from Jordan JM, Helmick CG, Renner JB, Luta G, Dragomir AD, Woodard J, et al. Prevalence of hip symptoms and radiographic and symptomatic hip osteoarthritis in African Americans and Caucasians: the Johnston County Osteoarthritis Project. The Journal of rheumatology. [Research Support, N.I.H., Extramural Research Support, U.S. Gov't, P.H.S.]. 2009 Apr;36(4):809–15. With permission from The Journal of Rheumatology]

Table 2.2 Weighted prevalence for four hip outcomes, by race/ethnicity, sex, and age group, Johnston County Osteoarthritis Project 1991–1997[a]

Racial/ethnic group	Age	Hip symptoms		Radiographic hip OA		Symptomatic hip OA		Severe radiographic hip OA	
		%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI
Caucasian									
Men	All	31.7	29.6, 34.0	23.8	21.9, 25.9	7.6	6.4, 8.9	2.5	1.9, 3.3
	45–54	30.3	26.5, 34.3	20.9	17.8, 24.5	6.6	4.8, 9.0	1.7	0.9, 3.5
	55–64	29.7	25.7, 34.0	18.5	15.8, 21.7	5.7	4.2, 7.8	0.9	0.5, 1.8
	65–74	33.5	29.9, 37.4	32.0	27.9, 36.3	8.3	6.2, 10.9	5.8	4.3, 7.9
	75+	40.1	32.7, 47.9	30.9	24.6, 38.0	16.2	11.3, 22.7	1.6	0.8, 3.3
Women	All	39.4	37.1, 41.6	29.1	27.1, 31.2	10.8	9.5, 12.2	2.3	1.8, 3.0
	45–54	30.6	27.6, 33.7						
	50–54			18.5	15.5, 21.9	4.1	2.6, 6.2	1.1	0.4, 3.1
	55–64	39.7	36.3, 43.2	25.1	22.1, 28.3	10.1	8.1, 12.5	1.1	0.7, 1.8
	65–74	45.1	41.2, 49.1	28.7	25.5, 32.1	11.3	9.2, 13.9	1.5	0.8, 2.8
	75+	45.2	39.7, 50.9	47.4	41.8, 53.2	17.6	45.5, 21.2	7.1	5.0, 10.1
African American									
Men	All	32.0	28.5, 35.8	33.2	29.6, 37.0	11.7	9.1, 14.9	2.7	1.7. 4.2
	45–54	26.1	21.0, 32.0	29.3	23.7, 35.6	5.7	3.2, 10.0	0.9	0.4, 2.2
	55–64	35.3	28.4, 42.8	34.2	26.7, 42.6	14.7	8.9, 23.4	1.5	0.6, 3.6
	65–74	41.7	35.7, 48.0	34.1	28.2, 40.6	16.9	12.8, 22.0	5.3	3.4, 8.1
	75+	21.1	12.9, 32.5	43.0	33.3, 53.2	12.9	6.0, 25.5	5.8	1.3, 21.9
Women	All	40.3	37.7, 43.0	31.2	28.2, 34.4	12.2	10.3, 14.5	3.5	2.7, 4.6
	45–54	36.3	32.1, 40.7						
	50–54			21.3	16.0, 27.7	7.8	4.4, 13.4	0.9	0.3, 2.3
	55–64	42.1	37.4, 46.9	23.6	19.9, 27.8	11.6	8.6, 15.5	1.4	0.5, 3.9
	65–74	42.0	37.4, 46.9	37.1	30.8, 44.0	12.3	8.7, 17.2	5.3	3.7, 7.5
	75+	42.1	34.2, 50.5	45.7	39.5, 52.0	17.7	14.0, 22.0	7.3	4.8, 10.9

[a]Weighted to the 1990 target population. Radiographic data were available for women only age 50 years and older [Reprinted from Jordan JM, Helmick CG, Renner JB, Luta G, Dragomir AD, Woodard J, et al. Prevalence of hip symptoms and radiographic and symptomatic hip osteoarthritis in African Americans and Caucasians: the Johnston County Osteoarthritis Project. The Journal of rheumatology. [Research Support, N.I.H., Extramural Research Support, U.S. Gov't, P.H.S.]. 2009 Apr;36(4):809–15. With permission from The Journal of Rheumatology]

Hip Arthroplasty

The most common condition for which total hip arthroplasty is done is severe OA of the hip [19]. In 2011, the National Center for Health Statistics reported that of the 230,144 total hip replacements surveyed, 85.5 % were due to OA [20]. The primary indication for this procedure is severe pain and related restriction in activities of

daily living [19]. To relieve discomfort and increase function of severe symptomatic OA, a hip replacement is an effective and in some cases, an only option. Between 1990 and 2002 the rate of primary total hip arthroplasties per 100,000 persons increased by approximately 50 % [21]. In 2006, total hip replacements, including revision procedures, accounted for 37.6 % of nearly one million inpatient arthroplasty procedures performed [20].

Total hip arthroplasties have been performed in an aging population with end-stage-hip OA. In 2010, Singh et al. reported a correlation between increasing age and increasing incidence of total hip arthroplasty over time [22]. In their population-based study of trends using hip arthroplasty between 1969 and 2008, they found that ages 0- through 49, 50- through 59, and 60- through 69-year age groups, the rate of total hip replacement usage gradually increased. They also reported peaks of utilization in 2005–2008, increasing more than sevenfold, and almost doubling between 1997–2000 and 2005–2008 [22].

Partial Hip Replacement

Partial hip replacement, generally a hemiarthroplasty in which the femoral head but not in the acetabulum is replaced, is performed principally for hip fracture (76 % of cases) [20]. Women have been reported to have higher incidence of fractures due to a greater prevalence of osteoporosis [20]. In 2006, the number of partial hip replacement procedures was estimated to be about 138,000 and 73 % of partial hip replacements were performed on females [20].

Revision Hip Replacement

Revision total hip replacement consumes a disproportionate amount of cost and other resources and involves more morbidity than primary total hip replacement. Using the Healthcare Cost and Utilization Project Nationwide Inpatient Sample database of 51,345 revision total hip arthroplasty procedures performed between October 1, 2005, and December 31, 2006, Bozic et al. found that a greater number of revision total hip arthroplasty procedures were performed on females compared to their male counterparts; 29,252, and 21,979, respectively ($n = 51{,}231$) [23]. They also discovered that 10,370 (20.2 %) patients in whom revisions were done were <55 years old, while the highest number of revisions, totaling 13,858 (27.0 %), were patients 75–84 years old. The oldest age group, 85–99 years old, constituted only 4423 or 8.6 % of revisions ($n = 51{,}315$) [23]. Similarly, Dorey et al. found that younger patients, especially those who are active and place a greater demand on their hip replacements, require greater numbers of revision

surgeries compared to older patients [24]. Geographically, the South (Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas) had the highest revision rates 18,867 (36.7 %), compared to the Northeast (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania), 8729 (17.0 %) ($n = 51{,}345$) [23]. The correlation between southern geographic location and higher revision rates could be due to profession, surgeon accessibility, and cost.

Socioeconomic Factors in Hip OA

Socioeconomic factors play a major role in the treatment of hip OA by total hip replacements. Previous investigations have suggested considerable differences among ethnic groups in the utilization of hip replacements, with rates of utilization being higher in whites than among minorities [25–28]. Escalante et al. found recipients of hip replacement less likely to be Hispanic than other hospitalized persons with a similar level of access to care [28]. They believed this under-representation involved factors such as access to health care and low socioeconomic status, among others [28]. According to Lavernia et al., however, African Americans and Hispanics are less likely to undergo a total hip arthroplasty for severe OA [29]. They suggested that minority populations are less likely to perceive any advantage of hip replacement and encounter barriers such as accessibility of surgeons, cost, etc. when considering total joint replacement [29, 30]. Compared to whites having THA or TKA, Hispanics and African Americans have worse preoperative function and an increased incidence of infection-related complications [29, 31, 32].

Educational level influences the prevalence of OA. Cleveland et al. analyzed data on 3087 individuals (68 % Caucasian and 31.8 % African American) from cross-sectional baseline data in the JoCo Project looking for an association between individual and community socioeconomic status (SES) measures with hip osteoarthritis (OA) outcomes based on educational attainment level. Of the 298 participants who had symptomatic hip OA, the mean age was 65.9, 60.1 % were female, 49.0 % had less than 12 years of education, and 54.4 % were considered the medium poverty level compared to the lower and higher poverty levels (18.8 % and 26.8 %, respectively) [33]. For this particular study, poverty was classified into three points of group poverty rates; low (referent), medium, or high community poverty rates [33]. The results of this study also support previous work showing a higher incidence of OA in females, a decrease in the age of patients with OA, and socioeconomic factors, such as education and poverty level correlating with the prevalence of OA.

Using data from the National Health and Nutrition Examination Survey (NHANES-I), Tepper et al. studied the relationship between years of education and radiographic hip OA. Although univariate logistic regression analyses suggested that higher educational level correlated with radiographic hip OA, a multivariate model determined that the relationship's statistical significance was marginal [33, 34]. However, a previous study in Norway reported a greater incidence of self-reported hip OA among those with fewer than 12 years of education [33, 35]. Also using the JoCo study, Murphy et al. suggested that participants with less than a high school education developed hip OA more than other participants [17].

Income has an influence on OA prevalence. According to the Health Care Utilization Project (HCUP), adults residing in high income communities had about 6000 more quarterly hospital discharges for primary hip replacement for OA than did those in the lowest income communities [36]. The greater hospital discharge rates for higher income communities could be multifactorial; ability to pay for surgery either out of pocket, or through insurance is higher with larger income families. Adults residing in the lowest income communities had about 7000 discharges per quarter in 2003, increasing to 12,500 discharges per quarter in 2010 [36]. In 2007, Agabiti et al. evaluated whether economic status affects the rate of having a total hip replacement using a multicity population-based longitudinal study. Analyzing hospital registries from four cities around Italy (Rome, Milan, Turin, and Bologna), they determined that low-income participants were less likely than high-income counterparts to have a total hip replacement, and low income was correlated with an increased risk of acute adverse medical events [37].

The average hospital cost for discharges of primary hip replacement for OA was similar for adults residing in the lowest and highest income communities, increasing from about $13,500 in 2003 to $16,500 in 2010 [36]. However, the average length of stay has decreased for both income levels. According to Steiner, the average length of stay for low income communities in 2003 was higher by 0.6 days than their higher income counterparts [36]. This could be due in part to a higher complication rate. The average length of stay for discharges with primary hip replacement in low income communities had decreased from 5.6 days in 2003 to 4.5 days in 2010, while higher income communities' average length of stay decreased from 5.0 days in 2003 to 4.0 days in 2010 [36]. Even though the length of stay has decreased for both income levels, the hospital cost for discharge has increased. This increase in costs could be due to inflation.

Projections

In 2007, Kurtz et al. performed statistical projections of the number of primary and revision total hip replacements between 2005 and 2030 based on historical Nationwide Inpatient Sample (NIS) data from 1990 to 2003. In 2003, 202,500

Table 2.3 Summary of sensitivity analysis of the projected number of hip and knee arthroplasties with use of models comparing variable prevalence (baseline) with constant prevalence

	Annual number of procedures (in thousands)[a]			
Type of procedure[b]	2005	2010	2020	2030
Primary total hip arthroplasty				
Variable	209 (193–225)	253 (232–273)	384 (339–435)	572 (481–681)
Constant	179 (156–202)	194 (169–219)	236 (205–268)	277 (240–315)
Revision total hip arthroplasty				
Variable	40.8 (34.9–47.0)	47.8 (40.3–56.1)	67.6 (54.0–83.9)	96.7 (72.1–130.0)
Constant	36.0 (29.5–42.6)	38.9 (31.8–46.0)	47.2 (38.3–56.0)	56.6 (45.8–34.5)

[a]The variable prevalence (baseline) and the constant prevalence are based on 1990 to 2003 data from the Nationwide Inpatient Sample

[b]The values are given as the projected value with the 95 % prediction interval in parentheses

[Reprinted from Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. The Journal of bone and joint surgery American volume. 2007 Apr;89(4):780–5. With permission from The Journal of Bone and Joint Surgery]

primary and 36,000 revision total hip arthroplasties were performed [38]. By 2030, the projections for primary and revision arthroplasty using the NIS data could range from two to five times greater than what Kurtz et al. projected (assuming constant surgery prevalence) (Table 2.3) [38]. According to Kurtz et al., the demand for primary total hip arthroplasty was estimated to grow by 174 %, from 208,600 in 2005 to 572,000 by 2030, while the number of revision arthroplasty procedures performed in 2005 was expected to grow from 40,800 to 96,700 in 2030 [38]. This affects both costs to the patient and the hospital.

Societal Impact

Cost of Care

OA is a major contributor to the total economic burden (1–25 % of the gross national product) of western nations [39, 40]. Leigh et al. placed the total annual costs of OA at $89.1 billion and estimated that between $3.4 billion and $13.2 billion of that expenditure was due solely to job-related OA, making job-related OA more costly than asthma and pulmonary diseases, and also more than renal and neurologic diseases combined [41, 42]. Job related injuries are defined as acute and repetitive injuries that are the consequences of job exposures [41].

OA contributes to a decrease in activities of daily living, and quality of life, and an increase in loss of workdays, all of which result in out-of-pocket costs to the patient. The World Health Organization (WHO) has estimated 10 % of the world's

population over 60 years old suffer from OA, 80 % of people with OA experience limitation of movement, and 25 % cannot perform major daily activities [43]. Estimated costs of hip OA are both direct and indirect.

Indirect Cost

The indirect cost refers to personal or family costs incurred such as lost wages, lost productivity, and expenditures resulting from the need for home care and childcare that would otherwise not be incurred [42]. Indirect costs are a large part of the overall economic burden of hip OA. In 2004, it was estimated that the annual indirect costs for OA was US$1760 per person (compared with US$3952 direct annual costs) [42, 44]. Information based on a claims database consisting of five million privately insured individuals put the indirect costs of OA at $4603 per person annually [42, 45]. Bitton reported one study that indicated that indirect costs amount to approximately one third of total costs [42, 44]. One observation reported that of 9933 participants from the Medical Expenditures Panel Survey (MEPS) who have OA, 92 % see physicians during the year, 34 % visit at least one OA specialist, 25 % see an orthopedist, 11 % a physical therapist, and 6 % a rheumatologist [39]. Another study found that OA accounted for 7.1 million (19.5 %) of all arthritis-related ambulatory medical care visits of which 4.9 million were female patients, while 2.2 million male [16]. These visits take time out of work for both the patient and the family member.

Direct Cost

Direct costs are expenses that are directly attributable to, in this case, OA, such as co-payments and fees for surgical treatment. Determining the results of direct costs of OA can be difficult due to diverse patient populations, different payers, different variables calculated, and different treatment locales [42]. One Canadian study from a government health plan found direct costs for OA patients were US$3952 per person per year based on 1999 and 2000 data in the province of Ontario [42, 44]. A study of claims filed with a US managed care plan between 1991 and 1993 compared the medical costs of OA patents with non-OA to determine the additional costs attributable solely to OA [42, 46]. They divided patients into two age groups: <65 years and >65 years [42, 46]. For the <65 years age group total annual costs were $5294, which was $2827 more than non-OA patients. OA patients 65 years or older had overall annual costs of $5704, which were $1963 higher than non-OA patients, suggesting together, OA costs are roughly double those of non-OA patients [42, 46].

Data from a managed care organization, over the course of 1 year starting in mid-1993, calculated direct costs as a combination of medication use, ambulatory care, and hospital care; the annual direct cost for 10,101 OA patients was just $543, while the total cost to the health maintenance organization was $4,728,425 [47]. Nearly half, $2,170,890 (46 %) was for hospital care and a third, $1,509,637 (32 %) was for medications [42, 47]. Treatment cost is higher for OA patients than RA patients due to the prevalence of the disease.

Hospitalization utilization greatly influences direct costs. Since 1992, the average length of stay (LOS) in the hospital following a total joint procedure has declined by 50 % [20]. Rates of discharge to home (routine), short-term/skilled nursing/intermediate care, or other discharge sites vary with age of the population and databases analyzed. According to one study, the mean hospitalization cost of hip and knee replacement procedures, not including charges not routinely billed by the hospital such as physician and prescription costs, increased between 1998 and 2007 by an average 109 % [20]. One-fourth of the growth was seen between 2004 and 2007, in spite of the reported shorter hospital length of stay for the procedures. Partial hip replacements (125 %) have shown the highest levels of increase [20]. Revision hip replacements with a mean increase of 86 % showed the lowest level of per procedure cost increase [20]. In recent years, the average hospital cost for discharges for primary hip replacement for OA has increased over time, from about $13,000 in 2003 to $16,500 in 2010 [36]. The increasing trend is projected to continue in 2011 and 2012, with the average hospital cost projected to be about $18,000 at the end of 2012. Using the Gross Domestic Product (GDP) price index, a cost of $13,000 in 2003 would be equivalent to a cost of $16,000 in 2010 [36]. Therefore, the average hospital cost through 2010 remained relatively constant and consistent with the cost expected by inflation alone [36].

Conclusion

Currently, there is no cure for OA. About 80 % of patients with OA have some degree of movement limitation; 25 % cannot perform major activities of daily living and 14 % require help with routine needs [48]. Treatment includes relieving symptoms and improving function, and can consist of a combination of patient education, physical therapy, weight control, use of medications, and eventually total joint replacement. The prevalence of OA is projected to increase. Females are at higher risk of developing OA, as well as patients who are obese, and socioeconomically disadvantaged. Minorities are more likely to have a higher complication rate after total hip replacement and less likely to have the surgery because of cost, healthcare disadvantages, and perceived barriers. The cost due to OA is also projected to increase. Even though the length of stay for a total hip replacement is decreasing, the direct and indirect costs of hip replacements are increasing for both low and high-income communities. As the societal and medical burdens of OA are growing in prevalence, so are the costs in treating and preventing it.

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