
Erectile Dysfunction

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Purpose: Male sexual health has taken on increased importance as the United States population ages, develops coexisting medical conditions and undergoes interventions that can affect sexual function. We characterized the burden and severity of disease, treatment patterns and economic consequences of erectile dysfunction.

Materials and Methods: The analytical methods used to generate these results were described previously.

Results: Erectile dysfunction was self-reported by almost 1 of 5 men and it increased with age. Erectile dysfunction may have been more commonly reported in Hispanic men and in those with a history of diabetes, obesity, smoking and hypertension. In most databases black American men had rates of use for office visits and inpatient hospital care that were twice those of other racial groups, although these rates were not controlled for comorbid conditions or other regional and socioeconomic factors. The use of diagnostic tests markedly decreased, while pharmacological therapy, especially with oral phosphodiesterase-5 inhibitors, markedly increased. Penile implant surgery continued to be performed with most patients electing inflatable devices. Extrapolating from the population based estimates of erectile dysfunction prevalence and current use trends showed that the cost of treatment nationwide could reach \$15 billion if all men sought treatment.

Conclusions: The burden of disease due to erectile dysfunction in the United States will increase with the aging of the male population, increasing prevalence of comorbid conditions, expanded treatment seeking behavior and costs of pharmaceutical therapy. Accurate estimates of economic cost will require better understanding of pathogenesis, treatment seeking behavior, patient preference for therapies, success of treatments and relative satisfaction with oral pharmacotherapy and penile implants.

Key Words: penis, impotence, health care costs, epidemiology

It is estimated that ED affects as many as 30 million men in the United States.¹ In 1985 the total direct costs for ED exceeded \$146 million,² although available data likely underestimate treatment use.³ Patient interest in and treatment for ED surged with the introduction of oral PDE-I in 1998. The emergence of effective, convenient and generally well tolerated new treatment options has contributed to increased public awareness, and greater acceptability of and attention to the health and socioeconomic impacts of male sexual health.

While ED is not life threatening, it may result in withdrawal from sexual intimacy, decreased quality of life, decreased working productivity and increased health care use.⁴ Dramatic changes in first line treatment options for ED are likely to lead more men to seek treatment. With men increasingly seeking to preserve sexual function and quality of life as they age, it is important to characterize the burden and severity of disease, treatment patterns and economic consequences of male sexual health.

MATERIALS AND METHODS

The analytical methods used to generate these results were described previously.

RESULTS

Definition and Diagnosis

ED is defined as the persistent "inability to achieve or maintain an erection sufficient for satisfactory sexual performance."¹ This definition suggests that ED prevalence, severity, treatment effectiveness and health care use may vary based on patient and partner perceptions and expectations about erectile function and sexual performance. Symptom based definitions⁵ are rapidly replacing the routine use of physiological measures of erectile function, such as penile tumescence. Self-administered questionnaires are useful adjuncts to the case history but in the clinical setting they are not sufficient to diagnose ED correctly or treat it safely.

The diagnosis and etiology of ED require a detailed sexual and medical history, physical examination and laboratory tests. The definition of ED provided by the National Institutes of Health does not include the duration of dysfunction but subsequent WHO recommendations specify a 3-month minimum duration of symptoms to establish that diagnosis⁶ except in cases of trauma or surgically induced ED. Objective physiological testing cannot substitute for patient self-report for establishing the diagnosis. Since the

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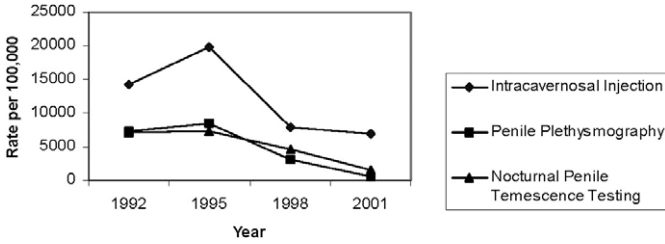


FIG. 1. Age adjusted rates of physician office visits for intracavernosal injection, penile plethysmography and nocturnal penile tumescence testing in Medicare beneficiaries with ED. Near overlap of curves for plethysmography and nocturnal penile tumescence testing may reflect use patterns in which clinicians perform each test in men with complex organic ED. Data were derived from separate CPT codes for penile plethysmography (54240) and nocturnal penile tumescence testing (54250). Unweighted counts multiplied by 20 to arrive at values, rate per 100,000 Medicare beneficiaries 65 years or older with ED age adjusted to 2001 with individuals of other races, unknown race and ethnicity, and other region included in total (source: Centers for Medicare and Medicaid Services, 1992, 1995, 1998 and 2001).

introduction of oral PDE-I therapy and the acceptance of goal oriented therapy for most cases of ED,⁷ the rationale for extensive testing has weakened, as reflected in the decreasing rates of intracavernosal injection, nocturnal penile tumescence and penile plethysmography (office based vascular testing) between 1992 and 2001 (fig. 1). Of note, because a 5% sample of Medicare records was used, national estimates of service use were determined by multiplying counts by a constant weight of 20 to represent use in the entire Medicare eligible population (fig. 1 and table 1). Specialized testing is often done in patients unable to ingest PDE-I because of contraindications, intolerance or lack of response. Other indications are young men with posttraumatic or primary ED and medicolegal investigations.

Risk Factors

Even after controlling for age related conditions known to be associated with ED, such as diabetes, heart disease, hypertension, dyslipidemia, depression and certain medications, the prevalence of ED increased with each decade of patient age.⁸⁻¹⁰

Prevalence

To obtain a better understanding of the national estimates of prevalence and risk factors for ED we examined data from the 2001 to 2002 release of the population based NHANES.¹¹ Almost 1 of 5 males experienced ED, as defined by respondent self-reports of being “sometimes or never able to get and keep an erection adequate for satisfactory intercourse.”¹¹ More than 75% of men older than 75 years met this criterion (fig. 2). ED also varied by race. Hispanic men were approximately twice as likely to report ED as white men after controlling for other factors known to be associated with ED, including diabetes, obesity and hypertension. The increased prevalence in Hispanic men overall was primarily due to high prevalence in those younger than 50 years.

Trends in Health Care Resource Use

Outpatient care. Recent trends suggest that the greatest increases in use and expenditures for ED in the future will be for outpatient evaluation and treatment. The age ad-

TABLE 1. Physician office visits by Medicare beneficiaries with ED as primary diagnosis

	1992			1995			1998			2001		
	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate
Totals all ages:	239,720	1,609 (1,581-1,638)	1,609	377,400	2,480 (2,445-2,515)	2,480	490,380	3,387 (3,345-3,429)	3,387	256,960	1,666 (1,638-1,695)	1,666
Total younger than 65	41,240	1,320 (1,264-1,377)	1,320	65,180	1,892 (1,828-1,956)	1,892	80,580	2,345 (2,273-2,416)	2,345	52,800	1,387 (1,335-1,440)	1,387
Total 65 or older	198,480	1,686 (1,658-1,719)	1,686	312,220	2,652 (2,611-2,693)	2,652	409,800	3,711 (3,661-3,761)	3,711	204,160	1,758 (1,724-1,792)	1,758
Age:												
65-69	89,420	2,197 (2,133-2,261)	2,197	138,880	3,605 (3,522-3,689)	3,605	162,080	4,800 (4,698-4,902)	4,800	78,320	2,213 (2,145-2,282)	2,213
70-74	67,160	2,066 (1,996-2,135)	2,066	103,160	3,094 (3,011-3,177)	3,094	137,160	4,496 (4,392-4,600)	4,496	66,040	2,145 (2,073-2,218)	2,145
75-79	29,420	1,300 (1,234-1,366)	1,300	50,040	2,206 (2,120-2,291)	2,206	76,300	3,341 (3,237-3,445)	3,341	40,320	1,644 (1,572-1,715)	1,644
80-84	9,540	728 (663-793)	728	16,300	1,173 (1,093-1,253)	1,173	27,520	1,997 (1,893-2,102)	1,997	15,180	1,014 (943-1,086)	1,014
85-89	2,680	449 (374-525)	449	3,440	540 (460-621)	540	5,880	904 (801-1,007)	904	3,660	506 (433-579)	506
90 or Older	260	128 (69-198)	128	400	189 (106-272)	189	820	381 (265-498)	381	620	268 (174-362)	268
Race/ethnicity:												
White	197,120	1,570 (1,539-1,600)	1,570	321,160	2,471 (2,433-2,508)	2,471	413,300	3,388 (3,335-3,425)	3,388	209,240	1,600 (1,570-1,630)	1,600
Black	26,500	2,077 (1,966-2,187)	2,138	41,760	3,016 (2,888-3,143)	3,095	54,200	4,061 (3,911-4,211)	4,130	31,060	2,117 (2,012-2,221)	2,157
Asian	Not available	Not available	Not available	1,120	1,537 (1,137-1,936)	1,454	2,200	1,604 (1,307-1,902)	1,531	1,920	937 (751-1,123)	888
Hispanic	Not available	Not available	Not available	4,420	2,236 (1,936-2,516)	2,246	9,820	2,926 (2,671-3,181)	2,920	7,120	1,895 (1,700-2,090)	1,874
North American native	Not available	Not available	Not available	380	1,889 (1,049-2,729)	1,988	580	2,074 (1,327-2,822)	2,146	80	240 (6.0-474)	240
Region:												
Midwest	51,420	1,386 (1,333-1,439)	1,401	81,460	2,113 (2,049-2,177)	2,135	110,680	2,993 (2,915-3,071)	3,023	53,700	1,414 (1,361-1,467)	1,419
Northeast	33,400	1,053 (1,003-1,103)	1,065	55,580	1,748 (1,683-1,812)	1,756	72,480	2,608 (2,524-2,692)	2,619	41,760	1,429 (1,368-1,490)	1,441
South	109,700	2,094 (2,039-2,149)	2,088	176,020	3,209 (3,143-3,274)	3,203	230,440	4,293 (4,217-4,370)	4,286	118,060	2,033 (1,982-2,084)	2,037
West	42,740	1,769 (1,695-1,844)	1,743	60,200	2,596 (2,504-2,688)	2,561	70,100	3,135 (3,032-3,237)	3,078	37,920	1,532 (1,464-1,601)	1,497

Unweighted counts multiplied by 20 to arrive at values, rate per 100,000 male Medicare beneficiaries in the same demographic stratum, age adjusted rate adjusted to the United States Census derived age distribution of the year under analysis, and individuals of other races, unknown race and ethnicity, and other region included in the total (counts less than 600 should be interpreted with caution) (source: Centers for Medicare and Medicaid Services, 5% Carrier and Outpatient Files, 1992, 1995, 1998 and 2001).

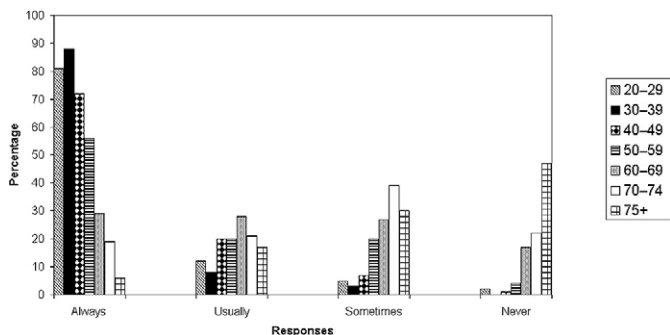


FIG. 2. Frequency of responses to question “How would you describe your ability to get and keep an erection adequate for satisfactory intercourse?” Bars represent patient age. Adapted from Saigal et al¹¹ based on NHANES data.

justed rate of physician office visits by Medicare beneficiaries primarily for ED doubled between 1992 and 1998 from 1,609/100,000 to 3,387/100,000 before decreasing in 2001 (table 1). A similar trend was seen for national hospital outpatient visits with ED listed as any diagnosis. These temporal trends were present across all racial, regional and age categories.

The 1998 peak in rates for physician office visits and hospital outpatient visits by Medicare beneficiaries may have been associated with the introduction of Viagra®. Consistent with this hypothesis was a corresponding large decrease in ED related inpatient surgery rates and expenditures in Centers for Medicare and Medicaid Services HCUP data.

The subsequent decrease in the rate of outpatient visits for ED listed as the primary diagnosis in the Medicare

databases may reflect the management of ED without physiological testing or diagnostic coding by primary care providers. Patients in these settings may have other conditions as the primary reason for the clinic visit. For example, the rate of male VA patients with ED listed as the primary diagnosis remained constant from 2000 to 2003 (2,012/100,000 in 2000 vs 1,981/100,000 in 2003). However, male veterans with ED listed as any diagnosis increased by more than 2,000/100,000 (3,161/100,000 in 2000 vs 5,236/100,000 in 2003) (table 2). Data from the VA Pharmacy Benefits Management Group demonstrated that the frequency of individual veterans receiving prescriptions for specific ED drugs as a class increased 9-fold from 1999 to 2003 from 23,913 or 681/100,000 in 1999 to 291,884 or 6,120/100,000 in 2003 (table 3).

Striking racial differences in rates of outpatient visits for ED were seen in all administrative databases (table 1). Black men had the highest rates and the difference between rates in black and white men was as high as 3 to 5-fold. Although these analyses were adjusted for age, they did not control for medical comorbidities, access to health care or socioeconomic and educational factors, of which all may contribute to the higher prevalence of ED and rate of outpatient visits for black men. In the VA system the rate of ED in black men was almost double that in white men (table 2). In contrast to self-reported ED status in NHANES the rate of an ED diagnosis did not differ notably between white and Hispanic male veterans.

Regional use of outpatient care for ED varied but did not show clear patterns across databases. Geographic variation may have reflected regional differences in health care delivery, referral patterns or racial population distribution.

TABLE 2. VA users with ED as any diagnosis in 1998 to 2003

	1998		1999		2000		2001		2002		2003	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Totals	94,120	2,865	98,061	2,794	117,337	3,161	154,838	3,790	201,988	4,515	249,120	5,236
Age:	107,879	2,907	104,224	2,808	117,337	3,161	140,432	3,784	167,011	4,500	193,121	5,203
Younger than 25	69	234	69	236	83	283	92	314	106	360	126	428
25-34	718	433	863	521	1,057	638	1,351	816	1,639	990	2,047	1,236
35-44	4,490	1,227	4,911	1,342	6,101	1,667	7,770	2,124	9,454	2,584	11,710	3,201
45-54	24,469	2,985	25,392	3,098	30,337	3,701	37,841	4,616	45,393	5,538	52,567	6,413
55-64	30,062	4,814	28,492	4,563	31,637	5,066	37,077	5,938	43,141	6,909	49,238	7,885
65-74	35,138	3,647	32,621	3,386	35,737	3,710	41,901	4,349	50,400	5,232	58,368	6,059
75-84	12,571	1,845	11,488	1,686	11,996	1,761	13,998	2,054	16,408	2,408	18,555	2,723
85 or Older	362	586	388	627	389	629	402	650	470	760	510	825
Male sex	94,120	2,865	98,061	2,794	117,337	3,161	154,838	3,790	201,988	4,515	249,120	5,236
Race/ethnicity:												
White	65,282	3,109	66,912	2,920	78,977	3,173	103,596	3,715	130,533	4,302	149,477	4,840
Black	20,606	4,361	21,301	4,416	24,813	5,111	29,815	6,109	35,822	7,332	40,694	8,540
Hispanic	2,602	2,869	2,856	3,042	3,321	3,451	3,909	3,892	4,987	4,834	5,874	5,815
Other	1,347	3,166	1,389	3,108	1,388	2,985	1,806	3,699	2,110	4,216	2,344	4,786
Unknown	4,283	738	5,603	938	8,838	1,488	15,712	2,384	28,536	3,576	50,731	4,863
Insurance status:												
No insurance/self-pay	64,909	2,710	67,587	2,682	75,431	3,062	91,781	3,720	113,099	4,464	133,255	5,286
Medicare	7,745	3,034	10,518	2,689	19,758	3,035	35,035	3,546	50,649	4,057	66,950	4,485
Medicaid	82	3,737	91	3,335	146	3,809	280	4,502	482	5,552	574	6,021
Private insurance/health maintenance organization	20,954	3,371	19,091	3,302	20,822	3,661	26,206	4,408	35,766	5,502	45,758	6,561
Other	430	3,838	773	4,449	1,173	4,999	1,494	5,537	1,888	6,190	2,494	6,965
Unknown	0	0	1	328	7	803	42	2,202	104	3,683	89	5,156
Region:												
Eastern	12,254	2,560	11,949	2,323	13,564	2,432	18,724	2,750	26,556	3,419	33,932	4,247
Central	16,333	2,830	17,672	2,822	20,968	3,240	29,359	4,038	43,546	4,862	59,240	5,625
Southern	35,016	2,802	36,150	2,702	46,592	3,224	61,257	3,775	84,219	4,664	105,465	5,430
Western	30,517	3,114	32,290	3,132	36,213	3,411	45,498	4,315	47,667	4,786	50,483	5,239

Rate per 100,000 veterans using the VA system (source: Inpatient and Outpatient Files, VA Information Resource Center, VA Health Services Research and Development Service Resource Center), age adjusted to 2000.

TABLE 3. Drug use for ED in veterans

	1999		2000		2001		2002		2003	
	Count	Rate (95% CI)	Count	Rate (95% CI)	Count	Rate (95% CI)	Count	Rate (95% CI)	Count	Rate (95% CI)
Totals	23,913	681 (673–690)	33,428	901 (891–910)	101,467	2,484 (2,469–2,499)	199,126	4,451 (4,431–4,470)	291,184	6,120 (6,098–6,142)
Age:										
Younger than 25	13	40 (18–62)	12	41 (18–64)	42	152 (106–198)	49	178 (128–228)	83	299 (234–363)
25–34	164	91 (77–105)	225	136 (118–154)	649	420 (388–453)	1,276	864 (816–911)	1,940	1,336 (1,276–1,395)
35–44	1,038	267 (251–283)	1,525	417 (396–438)	4,766	1,391 (1,351–1,430)	9,191	2,818 (2,761–2,876)	13,293	4,233 (4,161–4,305)
45–54	5,709	717 (698–735)	8,462	1,032 (1,010–1,054)	27,529	3,222 (3,184–3,260)	53,248	6,017 (5,966–6,068)	72,182	8,437 (8,376–8,499)
55–64	6,581	1,131 (1,103–1,158)	9,060	1,451 (1,421–1,481)	27,582	3,899 (3,853–3,945)	56,964	6,888 (6,831–6,944)	93,258	9,330 (9,270–9,390)
65–74	8,067	894 (874–913)	10,851	1,126 (1,105–1,148)	30,882	2,855 (2,824–2,887)	57,880	4,940 (4,900–4,981)	80,284	6,675 (6,629–6,721)
75–84	2,291	398 (382–414)	3,213	472 (455–488)	9,790	1,168 (1,145–1,191)	20,023	2,026 (1,998–2,054)	29,341	2,704 (2,673–2,735)
85 or Older	50	96 (70–123)	80	129 (101–158)	227	288 (251–326)	495	490 (447–533)	803	627 (583–670)
Race/ethnicity:										
White	16,262	714 (703–725)	22,123	896 (884–908)	65,240	2,364 (2,346–2,382)	120,232	4,139 (4,116–4,162)	153,784	5,551 (5,523–5,579)
Black	5,694	1,188 (1,157–1,129)	7,996	1,660 (1,623–1,696)	22,474	4,647 (4,587–4,708)	41,053	8,556 (8,474–8,639)	56,127	12,204 (12,103–12,305)
Hispanic	621	646 (595–696)	713	720 (667–773)	1,640	1,584 (1,508–1,661)	3,773	3,541 (3,428–3,654)	6,792	6,543 (6,388–6,699)
Other	322	740 (659–820)	394	874 (788–960)	1,331	2,823 (2,671–2,974)	2,170	4,605 (4,411–4,798)	2,897	6,601 (6,360–6,841)
Unknown	1,014	165 (155–175)	2,202	357 (342–372)	10,782	1,559 (1,530–1,589)	31,898	3,409 (3,372–3,446)	71,584	5,187 (5,149–5,225)
Insurance status:										
No insurance/self-pay	16,045	637 (627–647)	21,296	864 (853–876)	61,651	2,499 (2,479–2,518)	116,713	4,607 (4,580–4,633)	166,389	6,601 (6,569–6,632)
Medicare	2,801	716 (690–743)	6,015	924 (901–947)	22,592	2,286 (2,256–2,316)	47,234	3,783 (3,749–3,817)	72,461	4,854 (4,819–4,890)
Medicaid	28	1,026 (646–1,406)	67	1,748 (1,329–2,167)	231	3,714 (3,235–4,193)	506	5,829 (5,321–6,337)	720	7,552 (7,000–8,104)
Private insurance/health maintenance organization	4,833	836 (812–859)	5,697	1,002 (976–1,028)	15,966	2,686 (2,644–2,727)	32,630	5,020 (4,965–5,074)	48,493	6,953 (6,891–7,015)
Other	206	1,186 (1,024–1,348)	349	1,487 (1,331–1,643)	1,000	3,706 (3,477–3,936)	1,951	6,397 (6,113–6,681)	3,024	8,445 (8,144–8,746)
Unknown	0	0	4	459 (9–908)	27	1,416 (882–1,950)	92	3,258 (2,592–3,924)	97	5,620 (4,502–6,738)
Region:										
Eastern	2,394	465 (447–484)	2,654	476 (458–494)	7,689	1,129 (1,104–1,155)	18,113	2,332 (2,298–2,366)	26,678	3,339 (3,299–3,379)
Central	5,285	844 (821–867)	8,328	1,287 (1,259–1,314)	26,577	3,656 (3,612–3,700)	52,145	5,822 (5,772–5,872)	81,736	7,762 (7,708–7,815)
Southern	6,892	515 (503–527)	10,008	693 (679–706)	33,262	2,050 (2,028–2,072)	81,712	4,525 (4,494–4,556)	124,279	6,398 (6,363–6,434)
Western	9,342	906 (888–924)	12,438	1,172 (1,151–1,192)	33,939	3,219 (3,184–3,253)	47,156	4,734 (4,692–4,777)	58,491	6,070 (6,020–6,119)

Rate per 100,000 veterans using the VA system (source: Pharmacy Benefits Management, version 3.0, Department of VA).

TABLE 4. Expenditures for Medicare beneficiaries for ED treatment

Service Type	\$ Expenditures (% total)			
	1992	1995	1998	2001
Age 65 or older:				
Hospital outpt	1,400,440 (2.6)	1,009,700 (1.7)	1,493,400 (2.7)	1,062,100 (1.9)
Physician office	6,748,320 (12.5)	11,864,360 (20.1)	20,080,200 (36.1)	12,657,920 (22.9)
Ambulatory surgery	15,553,520 (28.9)	19,624,500 (33.2)	14,077,760 (25.3)	15,004,880 (27.1)
Emergency room	146,280 (0.3)	221,720 (0.4)	217,280 (0.4)	453,460 (0.8)
Inpt	29,937,600 (55.7)	26,348,220 (44.6)	19,756,620 (35.5)	26,154,120 (47.3)
Totals	53,786,160	59,068,500	53,625,260	55,332,480
Younger than 65:				
Hospital outpt	275,660 (1.5)	628,860 (3.0)	768,380 (3.7)	626,040 (3.0)
Physician office	1,402,160 (7.5)	2,607,200 (12.4)	4,109,580 (19.8)	3,907,200 (18.7)
Ambulatory surgery	3,842,800 (20.7)	6,045,000 (28.8)	5,193,840 (25.0)	6,079,580 (29.1)
Emergency room	74,740 (0.4)	92,400 (0.4)	83,160 (0.4)	150,880 (0.7)
Inpt	12,996,680 (69.9)	11,652,500 (55.4)	10,599,520 (51.1)	10,156,160 (48.5)
Totals	18,592,040	21,025,960	20,754,480	20,919,860

Source: Centers for Medicare and Medicaid Services, 1992, 1995, 1998 and 2001.

Although the prevalence of ED increased with each decade of patient age, data showed a pattern of differential age related outpatient diagnoses and treatment. VA users between ages 55 and 65 years had the highest prevalence of ED listed as any diagnosis (7,885/100,000 in 2003) (table 4). In NAMCS, which includes younger patients, the diagnosis increased sharply after age 45 years and peaked in the 65 to 74-year age range (6,025/100,000). In the Medicare population men 80 years or older had only half the outpatient diagnosis rate of men 65 to 69 years old (table 1). The decrease in treatment seeking by the elderly population likely reflected decreasing patient interest in ED treatments or a listing of an office visit primarily for ED despite a higher prevalence of the condition.¹²

Inpatient and ambulatory surgery care. Penile implants were once the only efficacious treatment for ED and for many years they accounted for the majority of hospitalizations and expenditures. Ambulatory surgery and inpatient expenses remained relatively constant from 1992 to 2001 and they became a proportionally smaller overall percent of expenditures until the most recent year studied,

when they increased (table 4). Between 82% and 88% of inpatient stays for men with a primary diagnosis of ED were for penile implant surgery.

Despite the increasing rates of ED diagnosis the rate of inpatient hospital stays decreased from 8.0/100,000 population in 1994 to 4.7/100,000 in 2000. This rate attained a nadir in 1998 at 3.8/100,000 population, coincident with the introduction of Viagra®. This trend was mirrored by HCUP data on national inpatient hospitalization in the Nationwide Inpatient Sample for 1994, 1996, 1998 and 2000 (data not shown).

Surgical trends. The total number of penile implants performed yearly decreased in the last decade, corresponding to the approval of pharmacological treatments for ED, including alprostadil penile injections, alprostadil urethral suppositories and oral Viagra® in 1994, 1996 and 1998, respectively (table 5). A greater percent of penile implants were inflatable rather than semirigid or malleable. The mean number of implant surgeries performed yearly at hospitals where at least 1 implantation was performed yearly decreased from 22.0 in 1994 to 16.1 in 2000.

TABLE 5. Inpatient hospital stays for ED as primary diagnosis by procedure rates for penile implants

	Count	Rate/100,000 Population (95% CI)	Rate/100,000 Visits for Condition (95% CI)
1994:			
Prosthesis or inflatable penile prosthesis	6,285	7.1 (6.8–7.5)	88,709 (84,263–93,155)
Semirigid prosthesis	1,206	1.4 (1.3–1.5)	17,022 (15,709–18,335)
Inflatable penile prosthesis	5,079	5.8 (5.4–6.1)	71,687 (67,608–75,752)
1996:			
Prosthesis or inflatable penile prosthesis	5,066	5.5 (5.2–5.8)	85,864 (81,119–90,627)
Semirigid prosthesis	859	0.9 (0.8–1.0)	14,559 (13,271–15,831)
Inflatable penile prosthesis	4,208	4.6 (4.3–4.8)	71,322 (66,983–75,644)
1998:			
Prosthesis or inflatable penile prosthesis	2,927	3.1 (2.9–3.3)	81,396 (75,250–87,514)
Semirigid prosthesis	437	0.5 (0.4–0.5)	12,152 (10,234–14,043)
Inflatable penile prosthesis	2,490	2.6 (2.4–2.8)	69,244 (63,654–74,833)
2000:			
Prosthesis or inflatable penile prosthesis	3,767	3.9 (3.6–4.2)	82,573 (75,712–89,413)
Semirigid prosthesis	639	0.7 (0.6–0.8)	14,007 (11,881–16,133)
Inflatable penile prosthesis	3,128	3.2 (3.0–3.5)	68,566 (63,218–73,915)

Rate per 100,000 based on 1994 to 2000 population estimates from Current Population Survey, CPS Utilities, Unicon Research Corp. for relevant demographic categories of adult male civilian noninstitutionalized population in the United States and rate per 100,000 adult male visits based on estimated number of visits for ED in HCUP National Inpatient Survey 1994 to 2000 (counts may not sum to total due to rounding) (source: HCUP Nationwide Inpatient Sample, 1994, 1996, 1998 and 2000).

TABLE 6. *Pharmacological management for ED in VA users*

	1999		2000		2001		2002		2003	
	Count	Age Adjusted Rate	Count	Age Adjusted Rate	Count	Age Adjusted Rate	Count	Age Adjusted Rate	Count	Age Adjusted Rate
ED medications for all males:	23,913	681	33,428	901	101,467	2,484	199,126	4,451	291,184	6,120
Alprostadil	18,583	529	20,010	539	20,128	493	20,569	460	20,339	427
Papaverine	1,900	54	1,722	46	1,564	38	1,219	27	1,014	21
Sildenafil	4,244	121	12,996	350	83,280	2,039	182,141	4,071	275,254	5,785
ED medications for all males with ED diagnosis	17,119	17,458	22,171	18,895	59,570	38,472	103,838	51,408	141,290	56,716
ED medications for all males about 40 yrs old:										
With prostate Ca	3,341	3,065	4,113	3,324	8,627	5,756	13,793	7,938	18,143	9,474
After radical prostatectomy	154	9,419	228	12,486	399	21,044	656	27,007	682	31,371
Sildenafil for all males about 40 yrs old:										
With prostate Ca	494	453	1,152	931	5,872	3,918	11,183	6,436	15,549	8,119
After radical prostatectomy	31	1,896	106	5,805	333	17,563	493	24,430	641	29,485

Rate per 100,000 veterans using the VA system (source: Pharmacy Benefits Management, version 3.0, Department of VA).

Complications and adverse events of surgical procedures for ED. The VA National Surgical Quality Improvement Program provided summary data on 706 veterans undergoing surgical treatment for ED in 1998 to 2003. Mean \pm SD operating room time for a penile implant during this period was 2.0 ± 0.9 hours. One or more complications occurring within 30 days were recorded in 42 of 706 men (5.9%). The most frequent complication was wound events at 83% of all complications. Approximately 4% of men required a return to the operating room within 30 days and only 2 (0.3%) died within 30 days of the procedure.

Pharmacological management for ED. National pharmacy claims data indicated that the prevalence of Viagra® use in males increased from 1.5% in 1998 to 2.9% in 2002.¹³ Use increased with age, in that approximately 6% of men older than 55 years had 1 or more Viagra® claims in 2002. The majority of Viagra® prescribers were primary care physicians, representing 69% of all prescriptions written in 2002 compared with 13% for urologists.

Data from the Department of VA indicated that the number of veterans receiving prescriptions for ED treatment, excluding testosterone therapy, increased 9-fold between 1999 and 2003 (table 3). The increase was seen across all age, race, region and insurance categories. It was particularly striking that 9.3% of 55 to 64-year-old men reported having filled a prescription for ED agents in 2003. By 2003 Viagra® made up approximately 85% of all pharmacological agents prescribed for ED and VA formulary policies listed Viagra® as the PDE-I of choice during this period. The use

of pharmacological agents by men with ED increased from 17,458/100,000 in fiscal year 1999 to 56,716/100,000 in fiscal year 2003 (table 6).

Economic Impact

Annual expenditures for ED in the United States reached almost \$330 million in 2000, increasing substantially from \$185 million in 1994. The economic impact of ED is further emphasized because these expenditures excluded pharmaceutical costs, which now comprise the majority of treatment related ED costs (table 7). For example, in 2005 national sales of Viagra® were reported to be \$1.6 billion, Cialis® sales were \$747 million and Levitra® sales were \$327 million.¹⁴⁻¹⁶

Patterns of expenditures for ED in the Medicare population age 65 or older differed from those in the general population. These Medicare enrollees accounted for \$55 million in expenditures in 2001. There was little change since 1992, indicating a decrease in real expenditures during the study period when inflation was considered. Because Medicare did not cover prescription drug costs during the study period, expenditures on pharmaceuticals were not captured in these data. Therefore, it is possible that the observed decreases in inpatient costs resulted from the availability of an effective pharmaceutical option.

Individual level expenditures for ED were estimated using risk adjusted regression models controlling for age, work status, income, urban or rural residence and health plan characteristics. Of 18 to 64-year-old males with employer

TABLE 7. *ED expenditures by service site*

	\$ Expenditures (% total)			
	1994	1996	1998	2000
Hospital outpt	6,438,236 (3.5)	7,011,462 (2.7)	13,563,958 (4.7)	12,941,222 (3.9)
Physician office	44,778,518 (24.2)	71,307,056 (27.5)	129,426,983 (45.1)	165,872,253 (50.6)
Ambulatory surgery	49,553,150 (26.7)	104,065,170 (40.2)	81,689,636 (28.5)	72,854,610 (22.2)
Emergency room	— (0.0)	— (0.0)	— (0.0)	— (0.0)
Inpt	84,524,707 (45.6)	76,573,597 (29.6)	62,444,428 (21.7)	75,958,763 (23.2)
Totals	185,294,611	258,957,285	287,125,005	327,626,849

Source: National Ambulatory and Medical Care Survey, National Hospital and Ambulatory Medical Care Survey, HCUP and Medical Expenditure Panel Survey, 1994, 1996, 1998 and 2000.

provided insurance average annual expenditures were \$4,813 for those treated for ED compared with \$3,706 for similar men not treated for the condition. Thus, an incremental cost of \$1,107 was associated with a diagnosis of ED.

DISCUSSION

The economic burden of ED is significant in the United States. While work loss is relatively low, expenditures for treatment are sizable. Although excess individual level costs were moderate for each patient, ED is relatively common. Almost 1.5% of privately insured males between ages of 18 and 64 years had at least 1 claim related to ED in 2002.

Recommendations

A better understanding of male sexual health is clearly needed. Future administrative and survey research should use validated questionnaires to establish the prevalence, severity, health impact and treatments used for ED. Analysis should establish racial and other influences on pathogenesis and treatment seeking behavior. Factors influencing the use of diagnostic testing should be investigated and guidelines for appropriate and selective use are necessary. Patient preference for therapies, success of treatments, and relative satisfaction with oral pharmacotherapy and penile implants must be studied. The growth of the aging male population will require economic modeling to predict future costs of evaluation and treatment. Additional research is needed to assess aspects of male sexual health not evaluated in this article, including premature ejaculation, sexual desire, vitality, ejaculatory and orgasmic function, partner intimacy, psychosocial aspects, testosterone replacement therapy and male andropause. Finally, female sexual health is important and under studied, and it requires evaluation.

CONCLUSIONS

ED was self-reported by almost 1 of 5 men and it increased with age. ED is more commonly reported in those with a history of diabetes, obesity, smoking and hypertension. In most databases black men had rates of use for office visits and inpatient hospital care that were twice those of other racial groups, although these rates were not controlled for comorbid conditions or other regional and socioeconomic factors.

Treatments used for ED suggest shifting forms of health care. The use of diagnostic tests markedly decreased, suggesting that the diagnosis of ED is being established by history and physical examination. Pharmacological therapy, especially with oral PDE-Is, has markedly increased. Penile implant surgery continues to be performed despite the success of PDE-I therapy with most patients electing inflatable devices. Extrapolating from the population based estimates of ED prevalence from NHANES, the cost of treatment nationwide could reach \$15 billion if all men sought treatment.

Abbreviations and Acronyms

ED	=	erectile dysfunction
HCUP	=	Healthcare Cost and Utilization Project
NHANES	=	National Health and Nutrition Examination Survey
PDE-I	=	phosphodiesterase-5 inhibitor
VA	=	Veterans Affairs

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