

Prevalence and Cost of Musculoskeletal Disorders: A Population-based, Public Hospital System Healthcare Consumption Approach

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ABSTRACT. Objective. To use a population-level, public-hospital approach to compare the prevalence and cost of musculoskeletal diseases (MSD) with other clinical specialties.

Methods. A healthcare utilization survey of 4 million individual records over 4 years, from all major public hospitals in the state of Victoria (estimated population 4.8 million residents in 2000/01) from 1997/98 to 2000/01. Main outcome measures were inpatient episodes of care, bed-days, and outpatient clinic encounters. MSD was defined as the combination of orthopedics and rheumatology.

Results. After obstetrics, MSD was the most frequent outpatient service, with orthopedics accounting for 9.9% of all visits in 2000/01. The proportion of MSD outpatient encounters (on average 11.6% of the total) was constant over the study period. Among 26 medical specialties, MSD had the sixth highest number of inpatient episodes (6.2% in 2000/01), following renal dialysis (14.6%), general surgery (8.2%), obstetrics (7.6%), gastroenterology (7.1%), and general medicine (6.7%). MSD was the fifth highest consumer of bed-days, occupying on average 7.7% of all beds per annum in the period 1997/98 to 2000/01, behind psychiatry (10.1%), respiratory medicine (8.5%), rehabilitation (8.3%), and general medicine (7.8%). MSD was the third most-costly discipline in 2000/01, with total costs of over A\$169 million (9.7% of total inpatient costs that year), behind respiratory medicine (11.6%) and general surgery (11.5%).

Conclusion. Compared to other diseases, MSD consumes a substantial proportion of healthcare resources in Victorian public hospitals. These data have important implications for allocation of healthcare resources, clinical care pathways, and prevention strategies. (First Release Nov 1 2007; *J Rheumatol* 2007;34:2466–75)

Key Indexing Terms:

MUSCULOSKELETAL DISEASES
RHEUMATIC DISEASES

HEALTHCARE COSTS
ORTHOPEDECS

BURDEN OF ILLNESS
COST OF ILLNESS

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Dr. Osborne's work was supported in part by the Baker Trust, Buckland Foundation, Arthritis Foundations of Victoria and Australia, and by a National Health and Medical Research Council (NHMRC) of Australia Population Health Career Development Award. Prof. Wicks is supported by an NMHRC Clinical Practitioner Fellowship.

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Accepted for publication July 6, 2007.

Healthcare systems in developing countries face increasing challenges, with projected increases in chronic disease and an aging population¹, but data to inform responses to these challenges are relatively scarce². Chronic diseases such as arthritis, osteoporosis, and other musculoskeletal disorders (MSD) are a major cause of disability worldwide³. This burden was recognized in 2000 by the establishment of the World Health Organization (WHO) Bone and Joint Decade Initiative. A key goal of the initiative is to reduce the burden and cost of MSD through a variety of strategies, including raising awareness of the growing burden of these diseases (<http://www.boneandjointdecade.org>).

Quantifying the burden of MSD at the population level is difficult. Population surveys indicate that in Australia, the prevalence of osteoarthritis (OA), rheumatoid arthritis, and other forms of arthritis is 7.3%, 2.3%, and 4.6%, respectively^{4,5}. These figures are similar to those from North America and Europe⁶ and across many other countries, but are based on self-report, which is associated with over-reporting and substantial error in disease specification. For example, confirmation of self-reported OA through clinical interview with rheumatologists or metrologists results in a 20% reduction in prevalence estimation^{7,8}. The prevalence of osteo-

porosis in Australia is also difficult to determine. In the 2001 National Health Survey, about 1.6% of Australians had self-reported osteoporosis⁹. The same survey also reported that prevalence increases with age, especially for women, with 10% of women aged 65–74 years and 15% of women over the age of 75 reporting the condition. The corresponding estimates for men were 1.2% and 1.5%⁹. A population-based study that used bone mineral density to diagnose osteoporosis reported a considerably higher proportion of osteoporosis in women aged 79 and over, with up to 87% of participants meeting the WHO criteria for osteoporosis¹⁰. These estimates were similar to results reported in the USA¹¹ and Europe¹², although figures vary according to the skeletal site and diagnostic criteria used.

In developed countries, noncommunicable chronic conditions have become the greatest burden on the healthcare system and people are living longer with nonfatal diseases. Since the prevalence of most major MSD increases with age^{4,8}, the proportion of patients will be higher in countries with an aging population. In Australia, the age structure is consistent with an aging population (median age of 35.2 yrs)¹³, and is similar to the population age structure of the USA (median age 35.2 yrs), but slightly younger than Canada (median age 36.9 yrs) and areas of Europe (median age 37.6 yrs for France, 37.7 yrs for the United Kingdom, 39.9 years for Germany)^{14,15}. While it is widely acknowledged that chronic disorders place a large burden on the individual and society as a whole, there have been few attempts to quantify this burden at the population level. The Global Burden of Disease studies combine several indirect measures of disease burden — death rates, impact on quality of life, and estimates of current and future disease prevalence rates across various levels of disease severity^{3,16}. Where available, the information on these indicators is obtained from local sources, or is otherwise extrapolated from international datasets to yield disability-adjusted life-years (DALY). DALY are one way of quantifying the influence of disease.

The approach we have taken is to directly quantify the current burden of MSD by calculating the consumption of hospital resources in the state of Victoria over a 4-year period, from 1997/98 to 2000/01. Victoria is one of 7 states and territories in Australia and has the second highest state population. This project comprehensively documents the burden of musculoskeletal (MSK) disease in public hospitals using a population-based, health system consumption approach.

MATERIALS AND METHODS

The Australian healthcare system. In Australia, provision of hospital services occurs at the state level, with financing provided through both the public and private sectors. Funding for public hospitals flows to each state or territory according to individual agreements with the Commonwealth government. In 1999/2000, the majority of funding for Victorian nonpsychiatric public hospitals was obtained from the Commonwealth (48.1%) and state and local (45.9%) governments. The remaining funds were derived

from nongovernment sources including health insurance funds and direct payments from patients¹⁷.

Much of the management of MSK problems occurs in the primary care setting, but as disease progresses care will often be required from rheumatology and/or orthopedic specialists. Australia's universal healthcare system, Medicare, is administered at the Commonwealth level and is partially funded through an income-dependent levy via taxation. Medicare provides free or subsidized primary care and free public hospital care for all Australian citizens. Australians also have the option of purchasing private health insurance that allows access to medical and surgical facilities in both private and public hospitals. In 2001, an estimated 8.8 million Australians (45% of the population) had private medical insurance¹⁸.

In Victoria in 2000/01, 63.9% of all patients requiring hospitalization were admitted to public hospitals and the remainder were treated in private hospitals. Overall, the majority of episodes of care in public hospitals (88.6%) are funded under Medicare. Medicare also funds 3.6% of hospitalizations in private hospitals¹⁹.

Data sources. Data on inpatient activity relates to patients admitted to hospital and includes day-only admissions. Patients who are not admitted but receive care from a hospital specialty clinic, department, or service are classified as outpatients. Data used for our study cover all inpatient episodes of care per annum, total bed-days per annum, and total outpatient encounters per annum for all public patients in all major Victorian public hospitals from 1997/98 to 2000/01.

Inpatients. The funding of inpatient episodes of care in Victoria is based on "case-mix." Case-mix uses clinical information to place episodes of care into categories that are the basis for reimbursement to hospitals. An episode of care can have up to 12 separate diagnostic codes and up to 12 procedure codes based on the International Classification of Diseases, Tenth Revision (ICD-10). The ICD codes together with information about patient's age, sex, comorbidities, and complications are used routinely to code the episode to a single diagnosis-related group (DRG), according to established criteria. During coding, each episode is also mapped to one of 23 major diagnostic categories (MDC). Each DRG represents a clinically coherent group based on similar patient characteristics and treatments, with each inpatient episode of care assigned only one DRG. Therefore it is expected that the quantity and type of resources used are on average the same for all episodes of care that fall under each DRG. This homogeneity allows DRG categories to be used in monitoring disease trends and evaluating inpatient care, in addition to healthcare funding. Victorian DRG are consistent with Australian Refined DRG, but the assignment process may vary with local practice. The DRG profile may also vary between countries due to differences in classification²⁰.

Each DRG is associated with a predetermined state-wide average patient length of stay (ALOS). In Victoria, a stay of either more than 3 times or less than one-third the State DRG ALOS is classified as outside the expected norm for the DRG²¹. Episodes within this range are "inliers." DRG coding is performed by specialized administrative staff, with clinical input and hospital DRG coding subject to regular audits. The average treatment cost for each DRG is measured annually in a sample of hospitals to derive DRG-specific cost weights. These weights reflect the cost of an episode of care relative to other DRG. The average cost of all episodes across all DRG has a cost weight of 1.0. Weighted inlier equivalent separations (WIES) are in turn calculated, taking into account the DRG class, its cost weight, and the corresponding number of inlier episodes of care.

In Victoria, WIES are a means by which public hospitals are reimbursed for the cost incurred in caring for each patient. In 2000/01, one WIES was equal to A\$2,223²², but the dollar value of each WIES changes a little from year to year. In 2000/01 for the public sector in Victoria, the average cost for DRG in the MSK/connective tissue disorders MDC was A\$4,158²². For our study, inpatient costs were calculated as the number of weighted separations multiplied by the dollar value of each WIES in each year studied.

Outpatients. Within the Victorian Ambulatory Classification System (VACS), introduced in 1997, medical and surgical outpatient clinics are

assigned to one of 34 medical and surgical specialties. Hospitals are funded on the basis of the number of patient encounters for each clinic. The clinic visit is reported by each hospital with funding based on a cost weight for each specialty, derived from statewide hospital costing data. The cost weight incorporates ancillary services such as radiology, pharmacy, and pathology, for up to 30 days either side of the visit. Allied health occasions of service are counted using an additional 11 VACS categories, but are funded by a separate block grant. In 1999/2000 the cost weights for orthopedics and rheumatology were 1.03 and 1.16, respectively. By comparison, the cost weight for general medicine was 1.10 and for cardiology 1.93²³. In 1999/2000 the standard case payment was \$109 per weighted encounter²³. This figure is adjusted annually for changes in the Consumer Price Index and salary awards. In practice, VACS payments to individual hospitals are fixed, based on previous activity levels. For our study, outpatient costs were calculated as the number of weighted encounters multiplied by the standard case payment in each year studied.

Data collection and statistical analyses. Each Victorian hospital provides annual DRG/WIES and VACS data to the Victorian Department of Human Services in a mandatory reporting system where these data are pooled and used for funding and allocation of resources. To undertake our study, complete annual VACS and DRG/WIES data were obtained from the Victorian Department of Human Services for each specialty area. All major public metropolitan and regional, adult and pediatric, general and specialty hospitals were included from 1997/98 to 2000/01. Some very small metropolitan and regional hospitals are not included in the VACS dataset. All inpatient episodes of care, bed-days, outpatient encounters, and WIES accrued per annum for MSD were compared with other specialty areas, and trends over time were documented.

Our study is therefore a population-based study of healthcare utilization in public hospitals, using about 4 million individual records over 4 years. For our purposes, MSD is defined as a combination of episodes of care assigned to the orthopedic and rheumatology specialties. Rehabilitation medicine comprises a substantial component of MSD management. However, accurate estimation of the proportion of rehabilitation medicine related to MSK diseases was not possible for our study. Private hospitals also provide many services for MSK diseases, but were not included as the necessary data are not systematically recorded.

Data analyses consisted of descriptive statistics — frequency of events (e.g., episodes of care) and percentage of total number of events for a specified time interval. Changes in the frequency of events over time were also calculated. To provide a clinical context for the MSK workload in the inpatient setting, clinically similar DRG were grouped.

RESULTS

Inpatient activity. The frequencies of inpatient episodes of care (separations) for each specialty area for each year from 1997/98 to 2000/01 are presented in Table 1. There were 1,065,572 total separations in 2000/01, including 65,812 (6.2%) separations for MSD. MSD ranked sixth (from a total of 26 specialty groupings) in the number of separations per annum, behind renal dialysis (14.6%), general surgery (8.2%), obstetrics (7.6%), gastroenterology (7.1%), and general medicine (6.7%).

Total bed-days for each specialty area for each year from

Table 1. Inpatient episodes of care per annum for each clinical specialty, 1997/98 to 2000/01.

Specialty	1997/98		1998/99		1999/00		2000/01	
	n	%	n	%	n	%	n	%
Renal dialysis	105,237	10.9	128,508	12.8	143,880	13.8	155,327	14.6
General surgery	81,140	8.4	83,167	8.3	85,218	8.2	87,057	8.2
Obstetrics	86,756	9.0	87,394	8.7	84,835	8.1	80,811	7.6
Gastroenterology	70,062	7.3	71,218	7.1	73,206	7.0	75,622	7.1
General medicine	59,345	6.2	62,476	6.2	65,606	6.3	71,012	6.7
Musculoskeletal disorders	61,476	6.4	63,533	6.3	64,297	6.2	65,812	6.2
Orthopedics	55,312	5.7	56,746	5.6	56,946	5.5	57,884	5.4
Rheumatology	6,164	0.6	6,787	0.7	7,351	0.7	7,928	0.7
Cardiology	57,183	5.9	58,816	5.8	60,716	5.8	64,345	6.0
Respiratory	53,917	5.6	54,308	5.4	55,440	5.3	56,862	5.3
Neonatology	50,670	5.3	52,391	5.2	52,172	5.0	51,695	4.9
Oncology/radiology	40,170	4.2	40,810	4.1	45,331	4.4	43,581	4.1
Psychiatry	35,826	3.7	38,178	3.8	39,703	3.8	40,766	3.8
Gynecology	39,868	4.1	40,022	4.0	39,226	3.8	37,711	3.5
Neurology	32,211	3.3	32,926	3.3	35,038	3.4	35,851	3.4
Ear, nose, and throat	34,961	3.6	33,576	3.3	33,791	3.2	32,659	3.1
Urology	29,491	3.1	29,612	2.9	31,290	3.0	32,461	3.0
Hematology	24,474	2.5	25,634	2.5	26,699	2.6	28,600	2.7
Ophthalmology	18,951	2.0	19,076	1.9	19,345	1.9	19,716	1.9
Plastic surgery	18,489	1.9	18,687	1.9	19,113	1.8	19,335	1.8
Rehabilitation	18,693	1.9	19,232	1.9	18,574	1.8	18,827	1.8
Endocrinology	9,364	1.0	9,689	1.0	9,961	1.0	11,721	1.1
Nephrology	8,104	0.8	8,027	0.8	8,561	0.8	8,858	0.8
Neurosurgery	7,655	0.8	7,750	0.8	7,937	0.8	8,156	0.8
Dental surgery	8,713	0.9	8,571	0.9	8,674	0.8	7,513	0.7
Vascular surgery	6,864	0.7	7,334	0.7	7,268	0.7	6,807	0.6
Cardiothoracic surgery	4,802	0.5	4,816	0.5	4,439	0.4	4,333	0.4
Other	275	0.0	1,847	0.2	1,515	0.1	134	0.0
Total	964,697	100.0	1,007,598	100.0	1,041,835	100.0	1,065,572	100.0

1997/98 to 2000/01 are presented in Table 2. MSD were the fifth highest consumer of public hospital bed-days, occupying 7.7% of total bed-days per annum in 2000/01. The 4 highest consumers of average bed-days in 2000/01 were psychiatry (10.1%), respiratory medicine (8.5%), rehabilitation (8.3%), and general medicine (7.8%).

Trends in inpatient activity from 1997/98 to 2000/01. During the study period, the number of inpatient episodes of care consumed by MSD increased by about 7.1%, from 61,476 in 1997/98 to 65,812 in 2000/01 (Table 1), with an average increase of 1.8% per annum. Over the period, orthopedics inpatient episodes of care increased by 4.6% and rheumatology increased by 28.6%. The overall number of inpatient episodes increased by 10.5% during this period, from 964,697 in 1997/98 to 1,065,572 in 2000/01, with an average increase of 2.6% per annum. Several other specialties showed an increase in the number of episodes of care, with renal dialysis (47.6%), endocrinology (25.2%), and general medicine (19.7%) showing the largest increases. Some specialties showed a decrease in the number of inpatient episodes over the study period, including dental surgery (13.8%), cardiothoracic surgery (9.8%), and obstetrics (6.9%).

Mean and median length of stay per inpatient episode of

care across all specialties remained relatively constant from 1997/98 to 2000/01 (7.7 and 5.3 days per admission, respectively). On the other hand, as shown in Table 2, the total number of bed-days increased by 4.3%, from 3,824,344 in 1997/98 to 3,990,496 in 2000/01, with an average annual increase of 1.1%. The proportion of bed-days for MSD increased by 5.3% during the same period, from 291,354 in 1997/98 to 306,903 in 2000/01, with an average increase of 1.3%. Although orthopedics bed-days increased by only 0.7% from 1997/98 to 2000/01, rheumatology had the largest relative increase of any specialty (50.7%). Other specialty areas also had an increase in annual total bed-days over the study period, with the most marked increase for renal dialysis (47.3%), endocrinology (36.7%), neurology (19.1%), hematology (18.9%), and general medicine (18.1%). Several specialty areas showed a decline in total bed-days per annum, including obstetrics (13.1%), gynecology (11.6%), vascular surgery (8.8%), cardiothoracic surgery (7.8%), and ear, nose and throat (7.5%).

Payments for inpatient care. Total WIES and associated costs for each specialty for each year from 1997/98 to 2000/01 are presented in Table 3. MSD were the third most-costly specialty in 2000/01, with 9.7% of the total WIES awarded to it during that year. The specialties that were

Table 2. Inpatient bed-days per annum for each clinical specialty, 1997/98 to 2000/01.

Specialty	1997/98		1998/99		1999/00		2000/01	
	n	%	n	%	n	%	n	%
Psychiatry	400,058	10.5	390,664	10.2	402,005	10.2	402,795	10.1
Respiratory	321,060	8.4	320,847	8.4	337,408	8.6	339,993	8.5
Rehabilitation	346,509	9.1	332,069	8.7	326,718	8.3	330,728	8.3
General medicine	262,854	6.9	258,995	6.8	292,443	7.4	310,534	7.8
Musculoskeletal disorders	291,354	7.6	290,386	7.6	302,053	7.7	306,903	7.7
Orthopedics	264,260	6.9	257,102	6.7	265,138	6.7	266,068	6.7
Rheumatology	27,094	0.7	33,284	0.9	36,915	0.9	40,835	1.0
General surgery	279,035	7.3	278,931	7.3	283,447	7.2	289,871	7.3
Neurology	202,347	5.3	200,800	5.3	225,681	5.7	240,983	6.0
Cardiology	226,588	5.9	226,307	5.9	231,130	5.9	234,450	5.9
Neonatology	247,853	6.5	245,879	6.4	235,460	6.0	232,163	5.8
Obstetrics	261,442	6.8	253,309	6.6	242,457	6.2	227,315	5.7
Gastroenterology	172,813	4.5	174,455	4.6	181,751	4.6	193,659	4.9
Renal dialysis	105,486	2.8	128,746	3.4	143,959	3.7	155,412	3.9
Urology	98,138	2.6	94,038	2.5	97,854	2.5	101,218	2.5
Hematology	67,858	1.8	73,510	1.9	78,158	2.0	80,694	2.0
Gynecology	81,492	2.1	77,487	2.0	75,121	1.9	72,010	1.8
Plastics	70,987	1.9	70,549	1.8	73,018	1.9	71,364	1.8
Oncology/radiology	67,617	1.8	68,911	1.8	73,599	1.9	69,877	1.8
Endocrinology	47,347	1.2	44,067	1.2	50,022	1.3	64,736	1.6
Ear, nose, and throat	58,860	1.5	56,599	1.5	55,129	1.4	54,463	1.4
Cardiothoracic surgery	52,156	1.4	51,133	1.3	48,820	1.2	48,069	1.2
Vascular surgery	52,046	1.4	53,747	1.4	54,974	1.4	47,457	1.2
Neurosurgery	38,157	1.0	37,825	1.0	39,061	1.0	41,330	1.0
Nephrology	34,589	0.9	34,483	0.9	35,164	0.9	38,221	1.0
Ophthalmology	25,940	0.7	25,019	0.7	24,785	0.6	24,890	0.6
Dental surgery	10,118	0.3	10,161	0.3	10,512	0.3	9,456	0.2
Other	1,640	0.0	25,742	0.7	9,481	0.2	1,905	0.0
Total	3,824,344	100.0	3,824,659	100.0	3,930,210	100.0	3,990,496	100.0

Table 3. Total weighted inlier equivalent separations (WIES) and estimated funding reimbursement* for each clinical specialty, 1997/98 to 2000/01.

Specialty	1997/98			1998/99			1999/00			2000/01		
	WIES		A\$	WIES		A\$	WIES		A\$	WIES		A\$
	n	%	Million	n	%	Million	n	%	Million	n	%	Million
Respiratory	84,305.4	11.1	184.8	86,650.7	11.3	190.4	91,062.4	11.6	200.1	91,644.9	11.6	201.3
General surgery	86,449.2	11.3	189.5	86,695.4	11.3	190.6	91,543.8	11.7	201.3	90,541.9	11.5	198.7
Musculoskeletal disorders	76,744.6	10.1	168.5	74,023.5	9.7	162.8	76,272.2	9.7	167.7	76,646.8	9.7	168.6
Orthopedics	72,172.8	9.5	158.5	68,916.1	9.0	151.6	70,968.4	9.0	156	71,159.9	9.0	156.5
Rheumatology	4,571.8	0.6	10.06	5,107.4	0.7	11.25	5,303.7	0.7	11.69	5,486.9	0.7	12.08
Cardiology	62,835.8	8.2	138.0	63,635.6	8.3	140.3	64,953.7	8.3	143.1	67,040.1	8.5	147.6
Obstetrics	56,660.8	7.4	123.4	56,462.9	7.4	123.7	56,415.0	7.2	123.5	54,923.0	7.0	120.2
General medicine	38,773.9	5.1	85.3	41,147.0	5.4	90.9	41,672.9	5.3	92.1	44,275.3	5.6	97.6
Neonatology	40,818.0	5.4	88.7	41,557.0	5.4	90.8	40,809.0	5.2	89.0	40,977.7	5.2	89.2
Gastroenterology	36,554.5	4.8	80.3	37,082.1	4.9	81.7	37,926.9	4.8	83.6	39,271.9	5.0	86.4
Neurology	34,932.1	4.6	76.5	34,694.6	4.5	76.3	36,041.4	4.6	79.3	35,814.8	4.6	78.6
Cardiothoracic surgery	32,788.5	4.3	70.9	32,145.1	4.2	70.0	30,532.4	3.9	66.0	30,032.9	3.8	64.6
Gynecology	27,021.5	3.5	58.5	26,323.2	3.4	57.3	26,243.8	3.3	57.0	25,592.1	3.3	55.5
Urology	24,207.5	3.2	53.1	22,806.5	3.0	50.1	23,757.4	3.0	52.3	23,908.0	3.0	52.5
Hematology	20,171.5	2.6	43.7	22,389.8	2.9	48.7	23,702.0	3.0	51.8	23,607.5	3.0	51.2
Plastics	20,854.2	2.7	45.6	20,647.4	2.7	45.4	22,171.1	2.8	48.6	21,227.0	2.7	46.6
Ear, nose, and throat	18,801.9	2.5	40.8	17,801.4	2.3	38.8	18,290.3	2.3	40.0	17,870.7	2.3	39.0
Oncology/radiology	15,236.4	2.0	33.3	15,334.3	2.0	33.6	16,136.4	2.1	35.3	15,404.3	2.0	33.7
Vascular surgery	17,209.0	2.3	37.8	17,408.6	2.3	38.3	17,333.2	2.2	38.1	14,856.3	1.9	32.7
Neurosurgery	14,632.3	1.9	31.5	14,522.1	1.9	31.5	15,124.8	1.9	32.9	14,754.8	1.9	31.9
Psychiatry	13,650.4	1.8	30.3	13,634.5	1.8	30.3	13,576.3	1.7	30.1	13,361.8	1.7	29.7
Endocrinology	9,302.8	1.2	20.5	8,623.3	1.1	19.0	9,296.8	1.2	20.5	12,369.1	1.6	27.2
Ophthalmology	11,583.1	1.5	24.7	11,166.3	1.5	23.8	11,649.8	1.5	24.9	11,943.7	1.5	25.5
Renal dialysis	5,346.5	0.7	11.8	6,522.5	0.9	14.4	7,319.1	0.9	16.2	7,910.1	1.0	17.5
Nephrology	7,780.2	1.0	17.0	7,037.3	0.9	15.5	7,331.9	0.9	16.1	7,504.1	1.0	16.5
Dental surgery	3,974.5	0.5	8.4	3,943.1	0.5	8.4	4,011.8	0.5	8.5	3,507.7	0.4	7.4
Rehabilitation	1,911.8	0.3	4.2	1,786.7	0.2	4.0	1,909.3	0.2	4.2	1,735.5	0.2	3.9
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.0	0.0	0.3
Total	762,546.5	100.0	1,667.2	764,041.1	100.0	1,676.3	785,083.6	100.0	1,722.1	786,837.3	100.0	1,724.0

* Calculated using 2000/01 equivalent categories and values.

more costly were respiratory medicine (11.6%) and general surgery (11.5%). The specialties that consumed the lowest proportion of fiscal resources (less than 1%) in 2000/01 were dental surgery and rehabilitation. The rank order of the most and least costly specialties was consistent over the 4-year study period (see Table 3).

Trends in payments for inpatient activity from 1997/98 to 2000/01. The overall cost of WIES reimbursements increased by 3.4% over the 4-year study period, from A\$1,667.2 million in 1997/98 to A\$1,724.0 million in 2000/01. The total payments for MSD remained virtually unchanged during this time, but composed a 1.3% decrease in orthopedics and a 20.1% increase in rheumatology. Several other specialties showed an increase in WIES reimbursements over the same period, including renal dialysis (48.3%), endocrinology (32.7%), and hematology (17.2%). Some specialties had a decrease in WIES reimbursements — vascular surgery (13.5%), dental surgery (11.9%), and cardiothoracic surgery (8.9%).

Composition of MSK workload 2000/01. Table 4 shows the broad composition of the MSK inpatient workload for

2000/01. In the orthopedic groupings, the most frequent DRG was fractures and related injuries, which composed almost a quarter of all MSK separations and a fifth of total bed-days. Spinal procedures were the next most common DRG, comprising 14.7% of separations and 12.6% of bed-days. Hip and knee arthroplasty were also common, composing 6.9% of all separations and 15.2% of total bed-days. In the rheumatology groupings, the broad category of bone disease and arthropathies was frequent, comprising 12.0% of separations and 13.3% of total bed-days. The specific DRG composing the orthopedic and rheumatology groupings are shown in Table 4.

Outpatient activity. The number and proportion of all medical/surgical outpatient encounters together with estimated cost for each specialty area for each year from 1997/98 to 2000/01 are presented in Table 5. MSD recorded the second highest number of outpatient encounters, with 11.2% of the total in 2000/01. Orthopedics alone accounted for 9.9% of total encounters. Obstetrics recorded the highest number of outpatient encounters per annum, with 17.9% of all encounters in 2000/01.

Table 4. Composition of major categories for inpatient musculoskeletal workload (2000/2001) based on diagnostic related groups (DRG)*.

Category	DRG	Total Separations		Total Bed-days	
		n	%	n	%
Orthopedics					
Arthroplasty					
Hip and knee joint replacement and revision surgery	103A, 103B, 103C, 104A, 104B, 105Z	4,518	6.9	46,501	15.2
Soft tissue and minor bony procedures					
Osteotomy, sprains, strains, dislocations, and aftercare of implants and prostheses	128A, 128B, 163Z, 173A, 173B, 173C	2,473	3.8	11,250	3.7
Foot procedures					
Amputation, arthrodesis, arthroplasty, osteotomy	120Z	1,961	3.0	4,696	1.5
Fractures and related injuries					
Femur	160Z, 161Z, 162A, 162B, 162C	1,998	3.0	23,796	7.8
Humerus and tibia	113A, 113B, 113C	3,010	4.6	14,049	4.6
Other bones (forearm, wrist, shoulder, hand, foot)	174A, 174B, 174C, 175A, 175B, 175C	11,104	16.9	29,955	9.8
Spine					
Nonsurgical procedures	168A, 168B, 168C	8,731	13.3	32,823	10.7
Surgical procedures	110B, 110A, 106Z, 109B	899	1.4	5,875	1.9
Knee procedures (non-arthroplasty, non-injury)		6,195	9.4	8,714	2.8
Lavage, debridement, meniscectomy, synovectomy	118Z				
Hip procedures (non-arthroplasty, non-injury)					
Fixation, repair, arthroscopy, grafts, osteotomy, arthrodesis, etc.	108A, 108B, 108C	2,938	4.5	35,436	11.5
Non-hip or knee procedures (non-arthroplasty, non-injury)					
Excision, aspiration, removal of prosthesis, sequestrectomy, reduction, and repair	116Z, 119Z, 122Z, 123Z	5,916	9.0	10,178	3.3
Infection and inflammation of bone and joints with muscle and connective tissue procedures					
Debridement, biopsy, excision, repair, sequestrectomy, resection, osteotomy due to infection, osteomyelitis, septic arthritis	112A, 112B, 112C, 164A, 164B, 167A, 167B	1,529	2.3	17,626	5.7
Malignancy					
Connective tissue malignancy, including pathological fracture	165A, 165B	3,572	5.4	15,795	5.1
Rheumatology					
Bone disease and arthropathies					
Inflammatory arthritis, connective tissue diseases (e.g., SLE), crystal arthritis and osteoporosis, degenerative or septic arthritis	166A, 166B, 169A, 169B, 169C, 170Z, 171A, 171B, 171C, 172A, 172B	7,918	12.0	40,758	13.3
Other	124Z, 101Z, 111Z, 117Z, 121Z, 125Z, W04Z, W60Z, W61Z, 107Z, 114Z, 176A, 176B, 176C, X62A, 128A	3,050	4.6	9,451	3.1
Total		65,812	100.0	306,903	100.0

* Further information about the DRG and related ICD codes can be found at <http://www.3.fhs.usyd.edu.au/ncch/7.1.htm> (accessed August 29, 2007).

Trends in outpatient activity from 1997/98 to 2000/01. Total outpatient encounters per annum for MSD have remained stable over the 4-year study period, with over a quarter of a million consultations each year (Table 5). Orthopedic outpatient encounters increased by 2.4% and rheumatology decreased by 9.9%. Overall, the number of outpatient encounters increased by 6.3% from 1997/98 to 2000/01, with an average annual increase of 1.6%. The specialties with the largest increase were oncology (42.5%), infectious disease (34.6%), and neurology (30.2%). Several specialties showed a substantial decrease in the number of outpatient encounters, including cardiothoracic surgery (36.8%), gynecology (23.1%), and dermatology (17.4%).

Payments for outpatient care. The estimated total cost of

outpatient activity in 2000/01 was A\$145 million. This amount excludes base funding provided to hospitals for outpatient activities (A\$42.3 million base grant, A\$24.4 million for teaching, A\$24.1 million for allied health, and A\$11.2 million for highly specialized clinics and other activities). In 2000/01, MSK outpatient care consumed A\$15.4 million, which is 11.2% of the throughput cost for that period. Orthopedics consumed A\$13.7 million and rheumatology A\$1.8 million, accounting for 9.9% and 1.2% of total outpatient costs in 2000/01. Only obstetrics had higher annual outpatient throughput costs during the same period, consuming A\$22.0 million (17.9%). When combined with the inpatient costs, the expenditure on MSD was approximately A\$184 million in 2000/01.

Table 5. Total outpatient encounters and estimated cost (million A\$) per annum for each speciality from 1997 to 2001.

Specialty	1997/98			1998/99			1999/00			2000/01		
	n	%	A\$	n	%	A\$	n	%	A\$	n	%	A\$
Obstetrics	164,359	15.2	17.3	184,498	17.3	19.8	204,074	17.9	22.0	205,310	17.9	22.0
Musculoskeletal disorders	126,847	11.7	11.3	129,124	12.1	13.3	128,214	11.3	14.6	127,968	11.2	15.4
Orthopedics	111,396	10.3	9.1	114,434	10.7	11.4	114,432	10.0	12.9	114,051	9.9	13.7
Rheumatology	15,451	1.4	2.2	14,690	1.4	1.9	13,782	1.2	1.7	13,917	1.2	1.8
Ophthalmology	76,389	7.1	5.2	83,698	7.8	5.1	78,407	6.9	5.1	77,768	6.8	5.6
General surgery	63,104	5.8	6.0	NA	NA	NA	64,417	5.7	6.1	62,433	5.4	7.1
PAC	46,546	4.3	5.3	52,489	4.9	6.3	55,743	4.9	7.9	58,268	5.1	10.3
Oncology	37,335	3.5	6.2	40,334	3.8	8.5	42,059	3.7	8.3	53,185	4.6	10.6
Plastics	50,451	4.7	4.0	50,457	4.7	3.8	50,475	4.4	3.9	48,823	4.3	4.2
Gynecology	53,518	5.0	6.4	52,749	4.9	5.2	49,122	4.3	5.5	41,136	3.6	5.2
Ear, nose, and throat	43,142	4.0	2.9	44,411	4.2	2.5	40,384	3.5	2.9	37,225	3.2	3.2
General medicine	34,633	3.2	3.9	36,413	3.4	4.3	34,740	3.1	4.2	33,980	3.0	4.3
Urology	30,880	2.9	3.6	34,159	3.2	3.8	31,911	2.8	3.6	34,203	3.0	3.9
Endocrinology	30,686	2.8	3.5	29,060	2.7	3.6	31,940	2.8	3.4	34,273	3.0	3.9
Gastroenterology	19,954	1.9	2.6	23,867	2.2	3.2	23,836	2.1	3.0	23,240	2.0	3.1
Nephrology	23,876	2.2	7.1	20,307	1.9	4.4	20,319	1.8	5.7	23,331	2.0	5.0
Dermatology	23,093	2.1	2.2	22,551	2.1	2.1	20,661	1.8	2.2	19,084	1.7	2.4
Infectious disease	19,189	1.8	4.0	19,559	1.8	3.7	24,312	2.1	5.1	25,832	2.3	6.0
Neurology	14,822	1.4	1.5	19,426	1.8	2.0	17,877	1.6	2.1	19,296	1.7	2.8
Dental	16,039	1.5	1.7	16,503	1.5	1.7	16,295	1.4	1.7	15,595	1.4	1.8
Cardiology	15,869	1.5	4.2	15,547	1.5	3.5	14,317	1.3	3.0	14,702	1.3	3.0
Vascular	14,752	1.4	1.6	14,338	1.3	1.6	12,115	1.1	1.4	12,763	1.1	1.6
Neurosurgery	9,861	0.9	1.4	10,382	1.0	1.5	11,560	1.0	1.7	12,675	1.1	1.3
Hematology	8,808	0.8	2.2	10,033	0.9	2.4	8,662	0.8	1.9	10,596	0.9	1.9
Pediatrics	8,879	0.8	NA	12,298	1.2	1.9	13,321	1.2	2.0	10,206	0.9	1.7
Respiratory	9,967	0.9	1.9	10,178	1.0	1.8	8,957	0.8	1.4	10,070	0.9	1.6
Cardiothoracic	8,066	0.8	1.4	5,222	0.5	0.9	5,409	0.5	1.1	5,101	0.4	1.1
Allergy	2,148	0.2	0.4	2,317	0.2	0.4	2,304	0.2	0.4	2,575	0.2	0.4
Total	1,080,060	100.0	118.9	1,069,044	100.0	120.6	1,139,645	100.0	134.9	1,147,606	100.0	144.5

PAC: Surgical preadmission clinic.

Trends in payments for outpatient care from 1997/98 to 2000/01. During the 1997/98–2000/01 period, the costs of MSK outpatient activity increased by 36.8% (an average increase of 9.2% per annum), compared with an overall increase of 21.6% (an average annual increase of 5.4%) in the cost of outpatient care. Orthopedics increased by 50.5% and rheumatology decreased by 18.2%. Only 4 other specialty areas had a larger percentage increase in outpatient costs than MSK medicine during the study period: surgical preadmission clinics (94.3%), neurology (86.7%), oncology (71.0%), and infectious disease (50.0%). Many specialty areas had a decline in the cost of outpatient activity, including nephrology (29.6%), cardiology (28.6%), and cardiothoracic surgery (21.4%).

DISCUSSION

The data we have interrogated are complete for the major public hospital services provided to 4.8 million residents of the second most populous state of Australia over the 4 years from 1997/98 to 2000/01. Our study provides new insights into healthcare activities in this population, which are relevant to many developed countries. MSD are among the major outpatient services by volume and cost, with ortho-

pedics ranked second only to obstetrics in number of outpatient encounters per annum. MSD outpatient encounters account for over 125,000 clinic visits each year. The overall estimated cost of outpatient care of MSD is over 11% of outpatient throughput costs (roughly A\$15 million) per annum. However, this is still likely to be a substantial underestimate of the hospital-based costs, as allied health and rehabilitation costs are not included. Despite a general trend towards ambulatory (outpatient) care in most specialty areas, inpatient DRG and WIES data indicate that MSD still constitute a substantial proportion of inpatient activity. From 1997/98 to 2000/01, MSD consumed the fifth highest average number of public hospital bed-days per annum, with no change in average length of stay per episode of care over this time. This indicates that while there are a growing number of same-day admissions, there is still a large number of inpatients with long and complicated admissions. These data highlight potential opportunities to improve clinical care pathways for inpatients with MSD.

Our study shows that MSK medicine composes a large proportion of both inpatient and outpatient activity in Victorian public hospitals. This disease burden is larger than many other community health problems and the results pro-

vide a framework for more informed decisions regarding allocation of resources in management, prevention, and research.

Orthopedics is the largest overall contributor to MSD management costs. The most common and costly DRG include internal fixation of osteoporotic femoral neck fractures, surgical management of traumatic fractures, hip and knee replacement surgery for advanced OA, and spinal procedures. Thus the data highlight areas for healthcare resource allocation, public health interventions to reduce the future burden of MSD, and optimization of inpatient clinical care. Healthcare strategies for chronic conditions are moving towards same-day care, increasingly earlier discharge with programs such as "hospital in the home," and more interdisciplinary management among specialists, general practitioners, and community health centers. These initiatives may shift some of the burden of MSD from the acute sector into primary care. Both primary and secondary prevention of MSK disease and its complications will be increasingly important²⁴.

Rehabilitation was the third highest consumer of average bed-days per annum. While it was not possible to compile data for MSD-related rehabilitation activity, a conservative estimate is that patients with MSD occupy at least one-third of the total rehabilitation workload. Similarly, neurosurgical intervention for back pain is not included here. Public outpatient allied health expenditures are also not fully recorded in our study. If these additional resources were taken into account, an even larger proportion of total healthcare resources could be attributed to the care of people with MSD. MSK ranked third in cost of inpatient care (A\$169 million in 2000/01). Although respiratory medicine and general surgery incur higher inpatient costs, when combined with the cost of outpatient care, MSD rank ahead of these specialties in total cost (A\$184 million in 2000/01).

The recent percentage increase in rheumatology inpatient activity was substantial, with a 28.6% increase in the number of admitted patients and 50.7% increase in the number of bed-days. No obvious administrative changes in the coding of rheumatological conditions occurred over this period, and the increase largely preceded the widespread use of short-stay admissions for "infusional therapies" (e.g., monoclonal antibody therapy). The reasons for the observed changes require further investigation, but it is of interest that there was a modest (9.9%) decline in rheumatology outpatient activity over this time.

An important limitation of our study is that the results are confined to the public hospital setting, as comprehensive data for private hospitals are not available. In Victoria, 42% of the population has private health insurance²⁵. While resource consumption in the private setting was not included, the MSD burden in this sector is likely to be substantial. Nonetheless the greatest burden due to chronic disease is known to fall on lower socioeconomic groups without pri-

vate health insurance^{25,26}. Another limitation is that the DRG system is somewhat insensitive, in that it assigns a single primary diagnosis. For example, hematemesis and malena due to consumption of nonsteroidal antiinflammatory drugs for pain related to OA would be coded as a gastroenterology admission. Therefore the volume of MSD services provided in public hospitals is probably a substantial underestimate of the overall prevalence and effect across the community.

Progressive OA often culminates in costly joint replacement surgery. Over the past 10 years, the number of elective total hip and knee replacements undertaken in Australia has almost doubled and annual growth in the public sector is about 5%²⁷. This increase is not reflected in our study, probably because of increasing waiting times for both orthopedic outpatients and for elective joint replacement surgery. Given that age and obesity are strongly associated with increased risk for OA onset and progression^{28,29}, reducing obesity may be a pivotal disease modification strategy³⁰. Occupational and sporting injury also contribute to the initiation and progression of arthritis; however, as with obesity, current preventive strategies have limited effect^{31,32}. These data, as well as projections from the burden of disease studies^{16,33}, indicate that MSK-related demands on the healthcare system will continue to increase.

Prevention strategies are especially pertinent in osteoporosis. While to date the most cost-effective preventive strategies are adequate exercise, diet, and sun exposure throughout life, high-risk groups are widely underdiagnosed and undertreated^{34,35} and are a priority for primary prevention. Given that fall-related injuries are the leading cause of injury deaths and disabilities among older adults, falls-prevention programs are an obvious target³⁶, as is correction of vitamin D deficiency in the elderly^{37,38}. Other major prevention opportunities include MSK road trauma, back pain, and work-related injuries. Each of these has been shown to be amenable to public health intervention strategies³⁹⁻⁴¹.

MSK complaints are the second most common reason for consulting a doctor and, in most countries, comprise up to 10%–20% of primary care consultations⁴². Many affected individuals only come to the attention of the hospital system following an acute event (e.g., fracture due to osteoporosis or intractable pain due to OA), as they are managed in primary care by general practitioners, allied health practitioners, or by complementary and alternative medicine practitioners⁴³⁻⁴⁵. The MSK burden that we have documented pertains to public-setting hospitalizations and outpatient encounters; it does not document primary care or individual burden associated with morbidity and mortality. Finally, the estimates also omit substantial lost productivity through inability to undertake paid and unpaid work⁴⁶ and the personal burden borne by individuals due to compromised quality of life^{47,48}.

This is the first primary-data acute health sector-wide

“positioning” of MSD public hospital workload against other specialties. We have shown that MSD contribute to a substantially greater burden of hospital workload than previously recognized. However, it is still likely to be a substantial underestimate of the overall MSD burden relative to other chronic conditions, because public hospital rehabilitation and allied health, private hospital, private specialist, and primary care MSK costs are not included in this analysis. Given that the burden of MSD is likely to increase, our data indicate that initiatives such as the Bone and Joint Decade and recognition of MSK conditions as an Australian national health priority are indeed timely. With the aging population, chronic diseases including many MSK diseases will continue to rise. Our data should assist healthcare providers address the MSD burden, both now and into the future. For example, high-cost, high-prevalence disorders requiring orthopedic surgery and prolonged hospital stays, such as hip fracture, will clearly require adequate hospital resources and should benefit from implementation of rigorous clinical care pathways. In addition to adequate resources and better implementation of clinical care pathways, our data also highlight the importance of primary and secondary prevention strategies to address MSD in the community. This may involve reviewing traditional medical models of care for chronic diseases and increased emphasis on patient education and self management⁴⁹⁻⁵². The use of large administrative datasets can reveal an important perspective on the healthcare system “in action” and complements other epidemiological approaches to assessing disease burden in a defined population.

ACKNOWLEDGMENT

We thank Victorian Department of Human Services, Melbourne, Australia, for providing data, especially Terese Barton for support with data acquisition and interpretation; and Dianne Beck for careful reading of the manuscript.

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