



**NATIONAL INSTITUTE OF CLINICAL STUDIES**

**The Prevalence of  
Chemoprophylaxis in  
Surgical and Medical Cases  
at High Risk of Venous  
Thromboembolism**

JUNE 2005

**TURNING EVIDENCE INTO ACTION**

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## Foreword

The prevention of venous thromboembolism in hospitalised patients is one of the clinical priority areas for the National Institute of Clinical Studies (NICS) because deep vein thrombosis and pulmonary embolism are largely preventable complications of hospitalisation, yet there is a substantial gap between current practice in Australia and evidence-based best practice.

The National Institute of Clinical Studies aims to improve the prevention of VTE in all hospitalised patients in Australia. The Western Australian Venous Thromboembolism Study was funded to inform the process of developing an effective intervention program to reduce the mortality associated with pulmonary embolism and morbidity associated with long-term complications of deep vein thrombosis in Australian hospitals.

Specifically we sought information on:

- the overall magnitude of the problem of VTE in hospital practice and how cases are distributed among surgical and medical specialties (see NICS 2005 *The Incidence and Risk Factors for Venous Thromboembolism in Hospitals in Western Australia 1999-2001*);
- the prevalence of chemoprophylaxis in high risk cases (this report); and
- trends in the incidence of VTE in hospitalised patients (see NICS 2005 *Trends in the Incidence of Venous Thromboembolism in Western Australian Hospitals, 1989-2001*)

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# The Prevalence of Chemoprophylaxis in Surgical and Medical Cases at High Risk of Venous Thromboembolism

## 1 Introduction

Randomised controlled trials provide unequivocal evidence that the prevalence of venous thromboembolism (VTE) in selected high-risk hospital cases can be reduced by chemoprophylaxis and physical measures such as intermittent pneumatic compression (IPC) and graduated elastic stocking (GES). The evidence for this has been extensively reviewed and forms the basis for clinical guidelines for prophylaxis in major reports such as those of the American College of Chest Physicians (ACCP) consensus conferences and the Scottish Intercollegiate Network Guidelines (SIGN) for the prevention of VTE (1-3). Despite this there is evidence to suggest that the implementation of guidelines has been slow, and there are few data that describe the present level of use of chemoprophylaxis, particularly at the population level (4, 5). Nor is there information on the actual or potential impact of clinical measures for the prevention of VTE on the total burden of this disease.

The objectives of this component of the study were to determine:

- i) The prevalence of pharmacological measures to reduce the risk of VTE in high-risk surgical and medical patients (chemoprophylaxis).
- ii) The demographic, clinical and institutional factors associated with use of chemoprophylaxis in hospital practice.

## 2 Subjects and methods

Information for this study was derived from two principal sources. The first was from information collected during the course of a case-control study to assess the impact of chemoprophylaxis against VTE in high-risk cases in hospital practice. The second source was from unpublished data from previous studies in Perth of medical and surgical management on the management of acute myocardial infarction (AMI) and coronary artery revascularisation procedures (CARPs).

### 2.1 Random sample of high-risk cases

The case-control study referred to above was focused on sub-groups of cases that either contribute substantial proportions of the total cases or have excessively high risks of VTE as identified in a previous descriptive study of the epidemiology of VTE in hospital practice in Western Australia 1999-2001 (6). While it would have been desirable to extend this to all cases of VTE, this restriction was necessary to ensure adequate statistical power.

- **High risk clinical sub-groups included in the study**

As our earlier descriptive study indicated that cases of VTE were distributed equally between medical and surgical admissions, selected medical as well as surgical cases were included in the study (6). After careful examination of the numbers of cases and risk of VTE in surgical and medical admissions, we selected the seven high risk strata that are listed in *Table 1*. The surgical conditions included: procedures on bones or joints of the lower-limb with and without associated a history of cancer (two groups); procedures on the brain, cerebral meninges or skull with or without associated cancer (two groups); and surgery of the digestive system with a history of cancer. The medical groups consisted of cases of respiratory disease (with or without a history of cancer) and cases in which cancer was the principal diagnosis but no surgical procedures were performed. The decision to stratify some condition groups on the basis of a current or previous history of cancer was made because such cases were found to have a nearly two-fold increase in risk of VTE in our descriptive study of the epidemiology of VTE in hospital practice in Western Australia, 1999-2001 (6).

- **Exclusions**

Same-day surgical admissions, which account for only 3.2% of all cases of VTE but 35% of total admissions for surgical procedures were excluded. Persons under 35 years of age, who also account for a very small proportion of total non-obstetric cases of VTE, were also excluded. As the study required collection of information from medical records, it was necessary for logistic reasons to restrict the study to major hospitals in the Perth Statistical Division (PSD). This included the three general public Teaching Hospitals and two major private hospitals.

- **Data sources**

Cases and controls fitting the study groups and other criteria described above were selected from the same file of linked hospital morbidity data records (HMD) used in the descriptive study of VTE in WA in 1999-2001 (6). To provide the most current information possible, cases and controls were selected from admissions occurring in 2002.

- **Hospitals included**

The hospitals included in the study are the three major public (Teaching) hospitals in Perth and two major private hospitals.

- **Definition of cases:**

- **Surgical VTE:** a diagnosis of VTE recorded as the non-principal diagnosis during a surgical admission (index surgical cases) OR in the main diagnostic field in a re-admission within three months of a previous admission for a surgical procedure (non-index surgical cases)<sup>#</sup>.
- **Medical VTE:** a diagnosis of VTE coded as a co-morbid condition in non-surgical admissions (index medical cases) or in the main diagnosis field in a re-admission within three months of a previous medical admission (non-index medical cases).

- **Random sample of high risk cases**

We selected a random sample of hospital admissions from the study hospitals stratified by hospital and clinical sub-groups. We initially intended to select 150 controls for each of the seven surgical or medical strata, evenly divided between each of the five study hospitals (30 cases from each condition stratum for each of the five participating hospitals (total 1050). Because one study hospital does not have a neurosurgical unit this was reduced to 990. The medical records for a further 40 cases were not accessible or were illegible and had to be excluded leaving a total of 950 cases, including 18 cases of VTE. The latter were excluded from the case-control study but retained in the study of the prevalence of chemoprophylaxis.

- **Data collection**

The hospital medical records of cases included in the study were examined by a research nurse using a standardised data collection form. The information collected included the anticoagulants and antiplatelet drugs that were being used immediately before admission, during admissions or prescribed at discharge. In cases taking either class of drug at the time of admission, it was noted whether this was continued or discontinued. The dates of commencement of chemoprophylaxis and surgical procedures (when relevant) were noted. For the purposes of this study individual generic and proprietary drugs have been re-coded as anticoagulants (heparins, warfarin or hirudoids) or as antiplatelet therapy (APT).

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<sup>#</sup> To determine the maximum interval between a surgical admission and subsequent readmission for VTE, we first examined the cumulative distribution of the time interval from an admission for VTE to the most recent admission for a surgical procedure up to twelve months. This demonstrated an exponential decline in the cumulative frequency of VTE with increasing interval to previous surgery such that approximately 80% of all cases with surgery in the past twelve months occurred within three months (6)

- **Statistical analysis**

The distribution of all admissions of the clinical conditions included in the study between the study hospital and other hospitals in the PSD was examined to determine the proportions of admissions for each clinical sub-group in each of the study hospitals and the remaining hospitals in the PSD. The sampling fractions for each hospital for each of the clinical sub-groups were then determined. Weighted estimates of the prevalence of chemoprophylaxis in each clinical sub-group were estimated to take into account different sampling fractions in each of the hospitals. Separate estimates were made for anticoagulants, APT and both combined (“Any” chemoprophylaxis).

In addition to estimating the prevalence of chemoprophylaxis in each clinical sub-group and each hospital, we examined variations in the prevalence of chemoprophylaxis in Teaching and Private hospitals, by age, gender, whether or not injury was present and by length of stay (LOS). While eventual LOS is not known at the time when chemoprophylaxis is commenced, we concluded that it could be used as a surrogate measure of case complexity that might influence clinical decisions relating to the use of chemoprophylaxis.

In order to examine the prevalence of chemoprophylaxis in selected high-risk procedures within the original surgical risk strata, we consolidated the groups of CNS procedures with or without a history of cancer and lower-limb procedures with or without a history of cancer into single groups of CNS and lower-limb procedures respectively. Multivariate analysis using logistic regression was used to assess the extent to which the use of chemoprophylaxis in the selected clinical groups is affected by other factors such as age, a diagnosis of injury and length of stay as a proxy for case complexity.

## **3 Results**

### **3.1 Part 1: Random sample of selected high-risk conditions**

#### **3.1.1 Composition of the sample**

*Table 1* shows the distribution of total hospital admissions (approximately 20,000) in the defined selected clinical sub-groups among the study hospitals, and other hospitals in the PSD. Approximately 60% of all cases were admitted to the study hospitals (40% in Public Teaching Hospitals and 19% in the private hospitals). The proportions of each risk-group included in study hospitals varied from over 70% in the case of CNS procedures to about 50% in non-surgical admissions for cancer. PSD hospital admissions in turn accounted for 80% of total State admissions (not shown) but this was higher for the surgical clinical sub-groups (ranging from 88% to 100%) compared with 67% of medical admissions for respiratory disease and 86% of medical cancer admissions.

**Table 1. Numbers of total admissions in selected clinical conditions in the PSD in study and other hospitals**

Surgical / Medical Stratum	Teaching hospitals	Private hospitals	Total study hospitals	Other hospitals	Total PSD
Digestive system	1023	717	1740	1107	2847
procedures with cancer history	35.9%	25.2%	61.1%	38.9%	100.0%
CNS	285	64	349	131	480
procedures with cancer history	35.9%	25.2%	61.1%	38.9%	100.0%
CNS procedures without cancer history	637	542	1179	461	1640
	38.8%	33.0%	71.9%	28.1%	100.0%
Lower Limb Bone/Joint	364	204	568	331	899
procedures with cancer history	40.5%	22.7%	63.2%	36.8%	100.0%
Lower Limb Bone/Joint	3286	3142	6428	4170	10598
procedures without cancer history	31.0%	29.6%	60.7%	39.3%	100.0%
Cancer primary diagnosis (medical)	2727	909	3636	3444	7080
	38.5%	12.8%	51.4%	48.6%	100.0%
Respiratory primary diagnosis (medical)	5252	769	6021	4188	10209
	51.4%	7.5%	59.0%	41.0%	100.0%
All Conditions	13574	6347	19921	13832	33753
	40.2%	18.8%	59.0%	41.0%	100.0%

### 3.1.2 Sampling fractions

*Table 2* summarises the sampling fractions for each clinical sub-group for total Teaching Hospital cases and total private hospital cases included in the study.

The study sample represented 4.8% of total admissions hospitals for the selected clinical sub-groups (4.1% of Teaching Hospital admissions, 6.2% of Private hospital admissions). Sampling fractions for all hospitals combined ranged from 2.4% of all respiratory cases to 29.8% of cases with a history of cancer having neurosurgical procedures. Sampling fractions were in general higher in Private hospitals than Teaching Hospitals.

**Table 2: Sampling fractions for clinical sub-groups by hospital type**

Surgical/ Medical Stratum	Teaching hospitals		Non-Teaching hospitals	
	Sample	Sampling fraction (%)	Sample	Sampling fraction (%)
Digestive system procedures with cancer history	88	8.6%	58	8.1%
CNS procedures with cancer history	58	20.4%	46	71.9%
CNS procedures without cancer history	60	9.4%	59	10.9%
Lower Limb Bone/Joint procedures with cancer history	89	24.5%	59	28.9%
Proc.s bone/joint lower limb not cancer	87	2.6%	60	1.9%
Cancer primary diagnosis (medical)	83	3.0%	58	6.4%
Respiratory primary diagnosis (medical)	90	1.7%	55	7.2%
All Conditions	555	4.1%	395	6.2%

### 3.1.3 The prevalence of chemoprophylaxis in selected clinical sub-groups

Table 3 shows the unadjusted and the weighted prevalence of chemoprophylaxis and the difference between these measures by clinical sub-group. The table is structured to show:

- (a) the prevalence of anticoagulants OR APT;
- (b) the prevalence of anticoagulants with or without APT
- (c) the prevalence of APT with or without anticoagulants

In general there was little difference between the unadjusted and weighted prevalence ratios of chemoprophylaxis between the clinical sub-groups. For convenience we have therefore used unadjusted prevalence ratios in the tables that follow.

**Table 3 Prevalence of chemoprophylaxis by Clinical sub-groups unadjusted and weighted for individual hospital sampling fractions**

Clinical sub-group	Total sample	Prevalence of chemoprophylaxis (%)		
		A Unadjusted	B Weighted	B-A
<b>(a) Anticoagulants or APT</b>				
Digestive system procedures with cancer history	146	83.6	83.5	-0.1
CNS procedures with cancer history	104	51.9	55.9	4.0
CNS procedures without cancer history	119	42.0	41.6	-0.4
Lower Limb Bone/Joint procedures with cancer history	148	64.9	64.4	-0.5
Proc.s bone/joint lower limb not cancer	147	53.7	52.5	-1.3
Cancer primary diagnosis (medical)	141	19.1	20.2	1.0
Respiratory primary diagnosis (medical)	145	41.4	47.2	5.8
All Conditions	950	51.4	51.9	0.6
<b>(b) Anticoagulants with or without APT</b>				
Digestive system procedures with cancer history	146	78.8	78.4	-0.4
CNS procedures with cancer history	104	45.2	50.3	5.1
CNS procedures without cancer history	119	37.8	36.6	-1.2
Lower Limb Bone/Joint procedures with cancer history	148	47.3	45.9	-1.3
Proc.s bone/joint lower limb not cancer	147	38.1	36.5	-1.6
Cancer primary diagnosis (medical)	141	11.3	11.3	0.0
Respiratory primary diagnosis (medical)	145	20.7	22.8	2.1
All Conditions	950	39.9	39.7	-0.2
<b>(c) APT with or without Anticoagulants</b>				
Digestive system procedures with cancer history	146	21.2	21.8	0.5
CNS procedures with cancer history	104	17.3	17.2	-0.1
CNS procedures without cancer history	119	10.9	12.5	1.6
Lower Limb Bone/Joint procedures with cancer history	148	35.1	35.7	0.6
Proc.s bone/joint lower limb not cancer	147	22.4	23.1	0.6
Cancer primary diagnosis (medical)	141	8.5	9.9	1.4
Respiratory primary diagnosis (medical)	145	25.5	29.4	3.9
All Conditions	950	20.6	21.5	0.8

From (a) it is seen that over half of all cases received either anticoagulants or APT.

This varied from 84% in digestive system procedures to 20% in medical cases with a principal diagnosis of cancer. The prevalence of chemoprophylaxis was higher in all the surgical strata than in medical strata, with the exception of procedures in CNS cases without a cancer history (42%).

**Table 4. Use of Anticoagulants (Heparin or Warfarin) and Antiplatelet Prophylaxis in selected Surgical/medical High Risk Groups**

<b>Procedure site or medical condition</b>	<b>Anticog &amp; APT</b>	<b>All Anticoag</b>	<b>All APT</b>	<b>APT alone</b>	<b>Anticoag. or APT</b>	<b>All cases</b>
Digestive system procedures with cancer history	24 16.4%	115 78.8%	31 21.2%	7 4.8%	122 83.6%	146 100.0%
CNS procedures with cancer history	11 10.6%	47 45.2%	18 17.3%	7 6.7%	54 51.9%	104 100.0%
CNS procedures, no cancer history	8 6.7%	45 37.8%	13 10.9%	5 4.2%	50 42.0%	119 100.0%
Lower Limb Bone/Joint procedures with cancer history	26 17.6%	70 47.3%	52 35.1%	26 17.6%	96 64.9%	148 100.0%
Lower Limb Bone/Joint procedures, no cancer history	10 6.8%	56 38.1%	33 22.4%	23 15.6%	79 53.7%	147 100.0%
Cancer primary diagnosis (medical)	1 0.7%	16 11.3%	12 8.5%	11 7.8%	27 19.1%	141 100.0%
Respiratory primary diagnosis (medical)	7 4.8%	30 20.7%	37 25.5%	30 20.7%	60 41.4%	145 100.0%
All Conditions	87 9.2%	379 39.9%	196 20.6%	109 11.5%	488 51.4%	950 100.0%

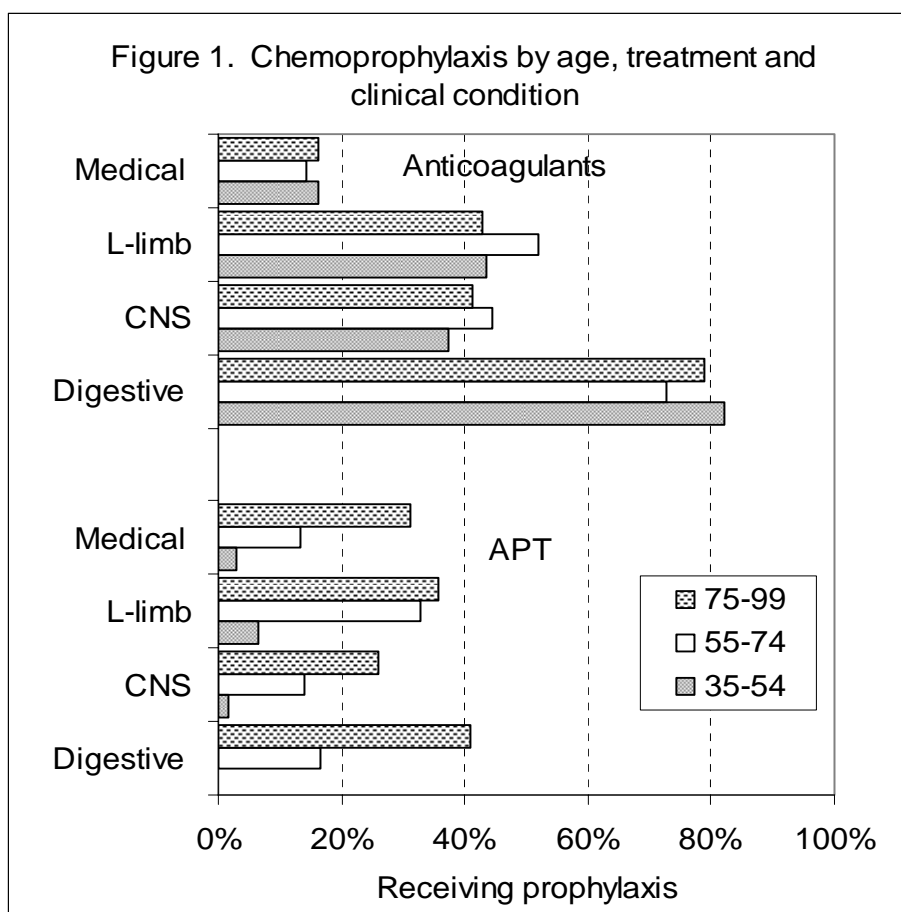
The prevalence of use of anticoagulants, while lower overall (40%), followed the same general pattern between clinical sub-groups as in part (a) but with much lower use in the medical strata and procedures on lower-limbs.

The use of APT with or without anticoagulants was lower again (22% in all cases) and was highest in procedures on the lower limbs with cancer history (36%), respiratory cases (29%) and procedures on the lower limbs without a history of cancer (23%).

The distribution of the type of chemoprophylaxis is shown by clinical sub-groups in *Table 4*. Over all clinical sub-groups, 51% received some form of chemoprophylaxis, with 40% receiving anticoagulants with or without APT. Only 12% received APT alone. The use of APT alone was highest in medical cases with respiratory disease (21%) and lower-limb procedures combined (17%). It thus constituted half of the use of chemoprophylaxis in respiratory cases and 28% of chemoprophylaxis in lower-limb procedures. The relatively high use of APT in respiratory cases may be due to co morbidity from ischaemic heart disease. The relatively high use of APT as chemoprophylaxis use in lower-limb procedures seems to be more purposeful. In contrast the use of APT alone in all other conditions was less than 6% and accounted for only 12% of treated cases.

#### **3.1.4 The relationship between chemoprophylaxis and age**

*Figure 1* shows the relationship between age and the use of anticoagulants and APT and by broad clinical sub-groups. Over all cases there was a slight increase in the use of anticoagulants with age (from 35% at 35-54 years to 44% at 75-79 years) but there was little evidence of trend in individual clinical sub-groups. In contrast, the use of APT increased with age from 3.2% in patients 35-54 years to 33.6% those 75-59 years. The trend was present in all clinical sub-groups but was least in lower limb procedures in which the use in persons 55-74 was only marginally less than in those aged 75-99 years.



As APT is used widely in the prevention of cardiovascular disease, we considered that the trend for this to increase with age in the present study may have been related to use of APT for other conditions. The use of APT upon admission and during hospitalisation is shown by broad age group in *Table 5*.

**Table 5. The use of APT prior to hospital admission by age**

Age group	Antiplatelet use				Number of cases
	On admission	Discontinued	New in hospital	All in hospital	
35-54	3.2%	1.8%	1.8%	3.2%	220
55-74	16.0%	4.9%	8.1%	19.2%	432
75-79	29.5%	4.0%	10.1%	35.6%	298
All ages	17.3%	3.9%	7.3%	20.6%	950

Over all ages, 17.3 % were taking APT at the time of admission but this varied from 3.2% in persons under 55 years, to 16.0% in those aged 55-74 years and 29.5% in those 75 years and over. In a small percentage of cases, APT was discontinued after admission (second column) but this was outweighed by commencement of APT in cases not previously on treatment (third column). This was again more likely to occur in older patients, but despite this over two thirds of cases receiving APT during the index hospitalisation were taking APT at the time of admission. *Table 6* shows information about APT use before and during hospitalisation in clinical sub-groups. There is marked variation between the sub-groups in treatment at the time of admission and during admission. In most, the majority of patients who received APT during hospitalisation were in fact taking this prior to admission, the exception being in lower-limb procedures with a previous history of cancer. In all lower-limb procedures, approximately half of the cases taking APT during the hospital admission commenced APT during the admission, compared with approximately 25% of cases in all other groups combined. The use of APT thus appears to be used more purposely for chemoprophylaxis in orthopaedic cases than in other specialty groups.

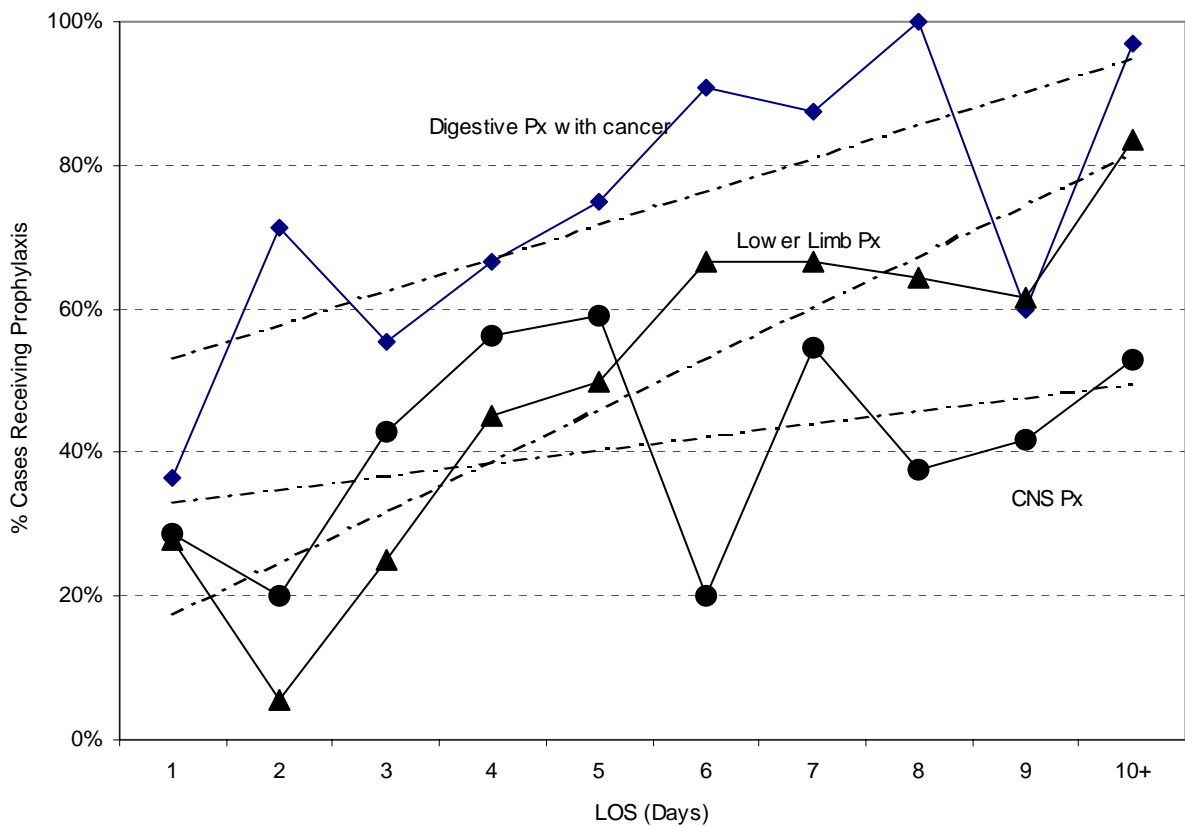
**Table 6. Antiplatelet drugs used before admission by clinical sub-group**

Procedure/ condition groups	On admission	Stopped In hospital	New in hospital	All in hospital	Number of cases
Digestive system procedures with cancer history	24.0%	6.2%	3.4%	21.2%	146
CNS procedures with cancer history	11.5%	1.0%	6.7%	17.3%	104
CNS procedures without cancer history	15.1%	6.7%	2.5%	10.9%	119
Lower Limb Bone/Joint procedures with cancer history	20.3%	4.7%	19.6%	35.1%	148
Proc.s bone/joint lower limb not cancer	17.0%	3.4%	8.8%	22.4%	147
Cancer primary diagnosis (medical)	10.6%	4.3%	2.1%	8.5%	141
Respiratory primary diagnosis (medical)	20.0%	0.7%	6.2%	25.5%	145
All Conditions	17.3%	3.9%	7.3%	20.6%	950

### 3.1.5 The relationship between chemoprophylaxis and length of stay

We examined the relationship between chemoprophylaxis and length of stay assuming this to be a surrogate for case complexity that might influence the use of chemoprophylaxis. This is illustrated in *Figure 2*. A positive association between use of chemoprophylaxis and increasing length is shown for each of the three surgical sub-groups. The gradient is most marked for procedures of the lower-limbs and least for procedures on the brain and skull. In a separate analysis positive but moderate gradients were found for the two medical strata (respiratory disease and cancer).

Figure 2. Prevalence of chemoprophylaxis for VTE by length of stay (LOS) in selected high risk surgical cases



### 3.1.6 The relationship between chemoprophylaxis and the presence of injury

Both the CNS and lower-limb procedures groups included cases admitted because of injuries. We considered it possible that such cases would be less likely to receive anticoagulants. There were 153 cases with injuries in the study. No difference was found in the crude prevalence of chemoprophylaxis in those with injury (54%) compared with all other cases (51%)

### 3.1.7 Multivariate analysis of factors associated with chemoprophylaxis

Factors associated with use of chemoprophylaxis such as age and length of stay may be highly correlated. A multivariate analysis using logistic regression was undertaken to: determine the separate effects of the various factors described above; assess the relative probability of chemoprophylaxis in clinical sub-groups after adjusting for other factors; and finally to determine the extent of institutional variation in the use of chemoprophylaxis after adjusting for clinical sub-groups and other factors. The factors included in the final models shown in *Tables 7 and 8* included age, gender, length of stay, injury, hospital and clinical conditions. When the use of either anticoagulants OR APT was used as the dependent variable (*Table 7*), the probability of chemoprophylaxis increased with age and length of stay. It was not significantly related to gender and was significantly decreased with injury (OR 0.44; 95% CIs 0.26, 0.74). There was considerable variation between hospitals in the probability of chemoprophylaxis with two hospitals having significantly higher probabilities of approximately 70% and 80% respectively, than the reference hospital. The probability of receiving treatment was substantially, and significantly, greater in procedures on the digestive system and significantly less in all other groups compared to the reference group (lower-limbs procedures).

**Table 7. Multivariate analysis of factors associated with chemoprophylaxis - anticoagulants and/or antiplatelets**

Risk factor	Total cases	Treated cases	% treated	OR	95% CI		P-value
Age (per year)	950	488	51.4%	1.03	1.02	1.04	0.00
<b>Gender</b>							
Female	468	246	52.6%	1.03	0.76	1.39	0.84
Male	482	242	50.2%	1.00	Reference group		
<b>Hospital</b>							
A	206	92	44.7%	1.00	Reference group		
B	145	92	63.4%	1.73	1.03	2.90	0.04
C	204	121	59.3%	1.82	1.16	2.85	0.01
D	204	95	46.6%	0.99	0.63	1.57	0.97
E	191	88	46.1%	0.95	0.59	1.51	0.82
<b>Clinical subgroup</b>							
Digestive procs	146	122	83.6%	2.58	1.46	4.58	0.00
CNS procs	223	104	46.6%	0.43	0.28	0.66	0.00
Lower limb procs	295	175	59.3%	1.00	Reference group		
Medical - cancer	172	46	26.7%	0.21	0.13	0.35	0.00
Medical - no cancer	114	41	36.0%	0.28	0.16	0.48	0.00
<b>Length of stay</b>							
1-2 days	192	42	21.9%	0.20	0.13	0.31	0.00
3-4 days	150	60	40.0%	0.48	0.32	0.72	0.00
5+ days	608	386	63.5%	1.00	Reference group		
<b>Injury</b>							
Yes	135	73	54.1%	0.44	0.26	0.74	0.00
No	815	415	50.9%	1.00	Reference group		

In *Table 8* the same basic model is used with anticoagulants only as the dependent variable. Age and gender have no apparent effect in the model, while the effect of injury, while less than unity is not significant. The positive relationship with length of stay is more pronounced than in *Table 7*, but there is little change in the values for individual hospitals or clinical sub-groups. The lack of an effect with age in this model is consistent with the findings from *Figure 1* that demonstrated a strong positive relationship with increasing age in the case of APT but only a weak association between age and use of anticoagulants.

**Table 8. Multivariate analysis of factors associated with chemoprophylaxis - anticoagulants**

Risk factor	Total cases	Treated cases	% treated	OR	95% CI		P-value
Age (per year)	950	379	39.9%	1.00	0.99	1.01	0.98
<b>Gender</b>							
Female	468	188	40.2%	1.03	0.76	1.40	0.85
Male	482	191	39.6%	1.00	Reference group		
<b>Hospital</b>							
A	206	66	32.0%	1.00	Reference group		
B	145	73	50.3%	2.19	1.28	3.75	0.00
C	204	90	44.1%	1.69	1.07	2.69	0.03
D	204	71	34.8%	1.12	0.69	1.82	0.65
E	191	79	41.4%	1.51	0.93	2.45	0.10
<b>Clinical sub-group</b>							
Digestive procs	146	115	78.8%	4.54	2.65	7.76	0.00
CNS procs	223	92	41.3%	0.78	0.51	1.19	0.24
Lower limb procs	295	126	42.7%	1.00	Reference group		
Medical - no cancer	172	24	14.0%	0.22	0.13	0.39	0.00
Medical - Respiratory	114	22	19.3%	0.28	0.15	0.50	0.00
<b>Length of stay</b>							
1-2 days	192	22	11.5%	0.13	0.08	0.22	0.00
3-4 days	150	40	26.7%	0.39	0.25	0.62	0.00
5+ days	608	317	52.1%	1.00	Reference group		
<b>Injury</b>							
Yes	135	53	39.3%	0.69	0.42	1.14	0.15
No	815	326	40.0%	1.00	Reference group		

In a further model (not shown) we repeated the above analysis with APT as the outcome variable. This differed significantly from the previous models in showing a much stronger and highly significant effects with increasing age and with injury. The effect of increasing length of stay was less than in the other models. The results for differences in use of APT by hospital were radically different from those shown for anticoagulants in Table 8, with all hospitals having significantly lower probabilities of treatment than the reference hospital (A). Similarly, the probability of treatment with APT was substantially and significantly less in all clinical sub-groups than in the reference group (lower-limb procedures).

### 3.1.8 The prevalence of chemoprophylaxis in selected high-risk procedures

While the clinical strata used in the study were selected on the basis of overall high absolute risks of VTE, there is nevertheless considerable variation in the risk of VTE within the clinical sub-groups that might be expected to be matched with variation in the prevalence of chemoprophylaxis. In *Table 9*, the prevalence of chemoprophylaxis is shown in selected procedures shown to be associated with particularly high risks of VTE or to account for a relatively large number of cases. (6) Because of the relatively small numbers of cases in the original clinical sub-groups, all procedures on lower limbs have been consolidated into a single group. In addition to the prevalence of chemoprophylaxis, *Table 9* shows, in the right hand column, the prevalence ratios of VTE for the selected procedures derived from detailed tabulations of VTE associated with individual surgical procedures used in the preparation of the descriptive study of VTE in Western Australia 1999-2001. (6)

**Table 9. The prevalence of chemoprophylaxis in selected surgical procedures at high risk of VTE**

PROCEDURE	Antcoag.+APT	Antcoag. only	APT only	Either	TOTAL	VTE/ 1000 procs*
<b>All digestive procs</b>	24	90	7	121	145	<b>17.1</b>
	16.6%	62.1%	4.8%	83.4%	100.0%	
Colorectal surgery	13	31	0	44	46	<b>20.4</b>
	28.3%	67.4%	0.0%	95.7%	100.0%	
<b>All lower limb procs</b>	36	82	48	166	285	<b>13.3</b>
	12.6%	28.8%	16.8%	58.2%	100.0%	
Hip replacement	11	31	16	58	74	<b>27.7</b>
	14.9%	41.9%	21.6%	78.4%	100.0%	
Knee replacement	10	18	6	34	40	<b>38.9</b>
	25.0%	45.0%	15.0%	85.0%	100.0%	
All hip + knee replacemnt	21	49	22	92	114	<b>33</b>
	18.4%	43.0%	19.3%	80.7%	100.0%	
Reduction # femur	9	13	13	35	55	<b>26.7</b>
	18.2%	48.5%	18.2%	84.8%	100.0%	
Other lower-limb procs	5	20	13	39	116	<b>10.1</b>
	4.3%	17.2%	11.2%	33.6%	100.0%	

\* Prevalence ratios of VTE from 1999-2001 descriptive study (6)

### ▪ Digestive system procedures

The digestive procedures stratum was selected to include cases with a current or recent history of cancer. The overall prevalence of VTE was 17 per 1000 procedures, with relatively high levels of chemoprophylaxis (79% received anticoagulants and 83% received anticoagulants or APT). In procedures involving the intestines and rectum, anticoagulants were received by 96% of cases.

### ▪ Lower-limb procedures

The overall prevalence of VTE in procedures of the lower limb was 13 per 1000 procedures and the prevalence of chemoprophylaxis 58.2% (41.4% anticoagulants with or without APT and 16.8% with APT alone). Levels of chemoprophylaxis were however substantially higher in total knee replacement procedures (85%), partial or total hip procedures or revisions (78%) and procedures for the reduction of femoral fractures (85%), which had high prevalence ratios of VTE of 37 per 1000, 28 per 1000 and 27 per 1000 respectively. The use of chemoprophylaxis in all remaining lower-limb procedures, which had a prevalence of VTE of 10 per 1000, was much lower at 34%.

The level of use of anticoagulants (with or without APT) was again highest in total knee replacement (70%), femoral fractures (67%) and hip replacement (57%) and lowest in all other procedures (22%).

## 3.2 Part 2: Results from cardiovascular studies in Perth

The results from this part of the study were derived from:

- (i.) The Perth Heart Attack Study conducted in 1998, using the WHO MONICA Project protocol (PHAS-98), and
- (ii.) The Western Australian collaborative study of coronary artery revascularisation procedures (WACCARP), 1993 – 1999

Both of these studies collected clinical information from samples of hospital medical records, including details of relevant cardiovascular drugs used during the hospital admission.

### 3.2.1 Acute myocardial infarction

*Table 10* shows the percentage of patients with AMI who received anticoagulants before during and after admission for AMI in 1998. Overall 92% received anticoagulants during the admission, ranging from 96% in patients under 65 years to 87% in those 75-79. We do not have information on the time after admission that anticoagulants were given but the fact that only 6% were using anticoagulants at the time of admission, and 13% at the time of discharge suggests that anticoagulants were generally given prophylactically.

Levels of use of APT during hospital admission for AMI increased to over 90% during the period of the Perth MONICA Study (1984-93) and remained at that level in 1998.

**Table 10. The use of anticoagulants for AMI in Perth in 1998. Perth MONICA-98 STUDY**

Age	Total cases	% receiving anticoagulants		
		Before	During	After
35-64	445	3.7	95.9	12.3
65-74	274	10.7	89.6	16.9
75-79	182	6.2	86.6	8.8
Total	901	6.4	92.0	13.1

### 3.2.2 Coronary artery revascularisation procedures (CARPs)

Table 11 shows the prevalence of use of anticoagulants during admissions for CARPs over the period 1993-1999 for both coronary artery bypass grafts (CABG) and percutaneous interventions (PCI). Over all years approximately 80% of cases of both CABG and PCI received anticoagulants. This did not vary over the period of study. The sample includes cases with acute coronary syndromes as well as those undergoing elective procedures. As in the case of AMI, 90% of cases with CARPs received APT during hospital admission.

**Table 11. Use of heparin during coronary artery revascularisation procedures in Perth 1993-99**

Procedure	Total cases	Heparin	% heparin
CABG	591	492	83.2
PCI	1443	1150	79.7
All CARPs	2034	1642	80.7

## 4 Discussion

The principal purpose of our study was to determine the extent to which preventive measures against VTE are used in hospital practice in Perth. We acknowledge that the study has several limitations stemming from logistic problems. By restricting our study to selected high-risk clinical conditions, we were unable to provide information on level of use of chemoprophylaxis in all hospital admissions or other conditions, which even if of lower risk, may still be important targets for chemoprophylaxis – for example other abdominal surgery, other vascular surgery and congestive cardiac failure. By further restricting the study to selected hospitals we cannot generalise our results to the whole of hospital practice in Perth or WA with confidence, even though the study hospitals nevertheless admitted 60% of all cases in the clinical sub-groups of interest and responsibility of the care of both surgical and medical cases would have been distributed widely between different specialists. We cannot however exclude the possibility that our results are affected by selection bias.

Finally, we found it impractical to collect information on the use of physical measures to prevent VTE such as intermittent pneumatic compression (IPC) and graduated elastic stockings (GES) because information on these alternatives is generally held separately from medical records in nursing or operating theatre notes and were thus not readily accessible. This omission is of concern because of the strong evidence that these measures have been shown to reduce the risk of VTE and are an important alternative to chemoprophylaxis in situations where this is withheld because of concern for bleeding (1, 3). The SIGN report emphasises the value of such measures for VTE prophylaxis in VTE in CNS and orthopaedic procedures and in trauma. In the context of this study, omission of this information could have led to underestimation of measures to prevent VTE in CNS and lower limb procedures (3).

In Part 1 of the study we demonstrated marked variation in the use of chemoprophylaxis in seven clinical sub-groups groups at high risk of VTE. Among the five surgical sub-groups, the highest prevalence of chemoprophylaxis (over 80%) was seen in procedures on digestive conditions with a history of cancer. In cases undergoing colorectal surgery this increased to 96%. The prevalence of chemoprophylaxis in procedures on bones of joints of lower limbs was considerably less at 56% overall but within this broad group, it was much higher (approximately 80%) in knee and hip replacement and in femoral fractures. In Part 2 we demonstrated that in cases of AMI and cases undergoing CARPs, the use of anticoagulants during hospital admission was approximately 90%. Thus high levels of chemoprophylaxis were found in several conditions that have been identified in major reports and clinical guidelines as being important targets for chemoprophylaxis (1-3).

The exception to the above was in procedures on the CNS, in which the overall level of chemoprophylaxis was 47%. Our attempts to analyse these results further were limited because of the non-specific nature of many of the CNS procedure codes and because small numbers limited our ability to categorise cases by specific disease conditions. The possibility of bleeding as a consequence of chemoprophylaxis is obviously of serious concern in neurosurgical cases and as noted above we were not able to determine the extent of alternative use of physical measures for VTE prevention. For these reasons it would be inappropriate to compare levels of chemoprophylaxis observed in our study with levels of chemoprophylaxis in other conditions.

While levels of chemoprophylaxis were high in the specific lower limb procedures described above, they were much lower in “other” procedures on lower limbs. While the risk of VTE in these cases is also correspondingly lower, it is nevertheless substantially higher than that for all surgical procedures (6). Due to the lack of evidence from clinical trials, clinical guidelines however provide minimal advice on this issue (1, 3). While it is probable that most procedures in this group are relatively minor with short durations of hospital stay, they may nevertheless be associated with prolonged post-discharge immobility as, for example in the case of below-knee fractures of the leg discharged with plaster casts. It would seem that more information is required on the prevalence of VTE in specific conditions within this sub-group to assess the need for prophylaxis.

The prevalence of chemoprophylaxis was relatively low in the medical sub-groups included in Part 1 of the study, particularly in cases with a principal diagnosis of cancer. While cases of cancer have been shown to have a high risk of VTE and account for 17% of medical cases of VTE (6), it is difficult, except in persons who have had a previous episode of VTE, to define intervention points in the natural history of cancer cases when chemoprophylaxis should be given. The need for chemoprophylaxis is recognised in Guideline documents in particular situations, such as prolonged immobilisation, in the presence of central venous catheters and in association with chemotherapy in some circumstances – for example advanced carcinoma of the breast (3), but it seems unlikely that this will adequately address the substantial problem of VTE in cancer patients.

In our study, the prevalence of chemoprophylaxis (36%) was higher in respiratory cases than in cancer cases. Clinical guidelines recognise the need for prophylaxis against VTE in severely ill patients with respiratory failure and infections such as pneumonia, but again the recommendations for chemoprophylaxis are much less clear-cut than in surgical cases (1, 3). Approximately half of the respiratory cases receiving chemoprophylaxis received APT alone and the majority of these patients were taking APT at the time of admission.

While it appears that anticoagulants (particularly heparins) are considered to be more effective than APT for chemoprophylaxis, expert groups disagree regarding the place of APT in chemoprophylaxis. The ACCP guidelines give little support for the use of APT, maintaining that anticoagulants are in nearly all instances more efficacious(1). The SIGN report on the other hand, on the basis of additional information from clinical trials of APT that was not included in the ACCP report, maintains that while APT may be less efficacious than anticoagulants in the prevention of DVT, it is more effective in preventing PE which is the more serious endpoint. (3) It recommends that APT in combination with IPC or GES can be considered equally with anticoagulants in lower-limb orthopaedic procedures.

Part 1 of our study found that 21% of all cases received APT and that this was the only form of chemoprophylaxis in 11%. The use of APT was strongly related to age and use prior to admission for other conditions so that in some cases its apparent use for chemoprophylaxis may have been fortuitous. The exception to this was in procedures of the lower limb in which the use of APT after admission seems to have been more purposeful - APT alone was used in 17% of cases compared with 5% in the remaining surgical groups and comprised nearly 30% of all chemoprophylaxis in the combined lower-limb procedures groups. While markedly different to chemoprophylaxis practices in the remaining surgical sub-groups, these results are nevertheless consistent with the SIGN guidelines (3).

In addition to variation in the use of chemoprophylaxis in clinical sub-groups, we found significant variation between individual hospitals after adjustment of clinical sub-groups, age, admissions for injury and length of stay. This was partly related to reciprocal differences in the use of anticoagulants and APT between some hospitals. Thus while there were in general high levels of chemoprophylaxis in the key conditions described above, there is also the possibility that this is influenced by institutional factors. The possible extent of this warrants further study.

## 5 Summary and conclusions

The prevalence of chemoprophylaxis was examined in a stratified random sample of 950 cases selected from seven high-risk clinical sub-groups and from registers of myocardial infarction and coronary artery revascularisation procedures. The use of anticoagulants and antiplatelet therapy (APT) were examined separately and in combination.

- (i.) Anticoagulants were the predominant form of chemoprophylaxis in all clinical sub-groups, with anticoagulants being used in 40% of all cases and APT in 21%. APT was the sole form of chemoprophylaxis in only 12% of cases. The use of APT alone was greatest in procedures on bone and joints of the lower limbs (approximately 16%) and in medical cases with a principal diagnosis of cancer (17%).
- (ii.) The frequency of use of APT increased with age and was frequently used before admission to hospital, suggesting that its use may have been related to other chronic disease. The use of APT for chemoprophylaxis against VTE appears to have been more purposeful in procedures on the lower limbs.
- (iii.) The frequency of use of chemoprophylaxis varied widely across selected clinical sub-groups ranging from approximately 90% in myocardial infarction and coronary artery revascularisation procedures, 80% in procedures on digestive system cases with cancer, 59% in lower-limb procedures, 47% in CNS procedures, 41% in medical cases with respiratory disease and 19% in medical cases with cancer.
- (iv.) Within the broad surgical sub-groups included in the study, higher levels of chemoprophylaxis were found in specific procedures recognised in clinical guidelines as being of particularly high risk of VTE. This included procedures on the intestines and rectum in cases with cancer (95%), knee and hip joint replacement (80%) and fractures of the femur (85%). Together with the results relating to myocardial infarction and coronary artery revascularisation procedures, these suggest that recommendations in clinical guidelines are being followed in key surgical and medical specialties.

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